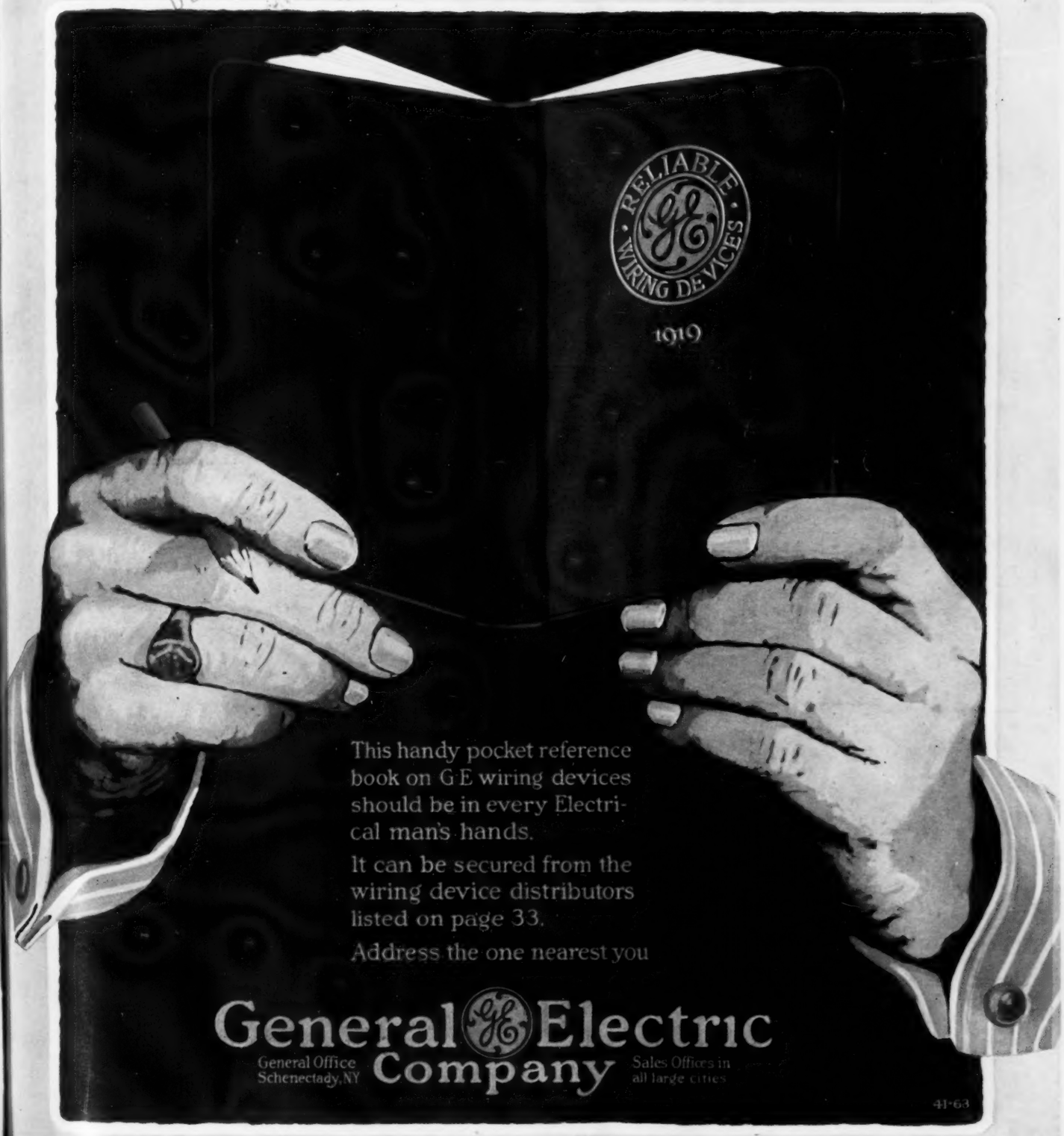
PUBLISHED DECEMBER 15, 1919, WITH CURRENT NEWS

Electrical World

McGraw-Hill Company, Inc. New York, Nov. 29 & Dec. 6, 1919 Fifteen Cents a Copy

DEC 19 1919


RELIABLE
WIRING DEVICES
1919
This handy pocket reference book on G E wiring devices should be in every Electrical man's hands.
It can be secured from the wiring device distributors listed on page 33.
Address the one nearest you
General Electric Company
General Office Schenectady, NY
Sales Offices in all large cities
41-63

On Guard!

WESTON WATTMETER
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
KILOWATTS
WESTON ELECTRICAL INSTRUMENT CO.
NEWARK, N.J., U. S.A.

Weston

Electrical Indicating Instruments

are unqualifiedly superior in construction, accuracy and service to any other instruments designed for the same purpose.

Weston models include complete Switchboard and Portable groups for service on A. C. or D. C. circuits, and also many Instruments designed for special purposes. There is a Weston model for every electrical measurement need.

Write for catalog or bulletin, specifying the field that interests you.

Weston Electrical Instrument Co.
13 Weston Ave., Newark, N. J.

Branches in Principal Cities of the United States and Throughout the World.

Published December 15 With Current News

Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 74 New York, Saturday, Nov. 29 and Dec. 6, 1919 *Number* 19

Export Trade Outlook

THE largest electrical manufacturing companies have set their houses in order with reference to export business, but the smaller companies either have not given the matter the attention it deserves or else have dismissed it from their programs entirely. Surely the opportunities are too great and the markets of the world too alluring to permit the matter to go by default or to allow the trade to gravitate entirely into the hands of the larger companies. The call is to every American manufacturer and none should excuse himself. Times have changed and so have conditions. Our national, financial and economic position has been reversed. Dollar exchange predominates. American ships traverse the seven seas in theory if not yet in fact, and our actual and potential wealth has been immensely increased. Moreover, the United States alone of all the great nations possesses a vast amount of raw material, finished and semi-finished products available for export. Europe and South America are heavily indebted to us as a result of the war, and American credit is established throughout the world. Thus, in the next few years there are opportunities for America such as we have never known before. Competition will be keen enough in export trade when Germany and England are in a position to engage energetically in it again. Meanwhile, American manufacturers should do all in their power to strengthen their position, so that when competition does come they will not be easily dislodged.

Face the farm-lighting problem fairly. The farmer will be served. He wants to "hook on to a power line." Work up one or two standard propositions for him and file rates adequate to cover the service.

A Need for Operators

THE use of arc-welding equipment and electric furnaces is limited in many instances by the dearth of skilled operators. Arc manipulators who can do simple welding under the supervision of an expert can be taught in schools in a few months, but it requires experience to set up and weld difficult work properly. Electric furnace operators can be developed somewhat more rapidly than welders, but they can only get the necessary practical experience where furnaces are used commercially. However, such concerns have shown no great willingness to admit to their plants potential furnace operators for their competitors.

Central stations and the manufacturers of furnace and electrical equipment are vitally interested in augmenting the supply of operators, but with few exceptions they are unable to give would-be operators the practical experience they need. The situation is one which is deserving of the best thought of the industry, in order that electric welding and electric furnace operations may be developed quickly to the limit which emergency needs during the war have revealed.

Exceptions to the general statement that production per man is at a lower ebb than for years are beginning to appear in electrical manufacturing plants. The manager of one great establishment reports that the best output per employee in the factory's history has now been attained, and along with this goes a contentment with the day's work and its compensation which is bringing real business into the community. Bolshevistic agitators have literally been "kicked out of town" by public sentiment, and the course has been set for prosperity.

Water-Power Development Urgent

ALTHOUGH the European war came to an end more than a year ago, the conditions surrounding the coal supply of the country are almost as bad now as they were during the war. This is significant because the question of coal supply is a purely domestic one and has nothing to do with international affairs. Fortunately for the electric public utilities of the country, when the crisis became apparent the National Electric Light Association immediately resurrected its committee on gas and electric service, which has worked in close co-operation with Fuel Administrator Garfield to good advantage. Nevertheless, as a result of the coal shortage many cities throughout the country have had to return to war-time restrictions on the use of light and power. Meanwhile, the water-power bill is awaiting action by Congress, and it would be vain to predict when the powers of our falling waters will be unloosed for development. The enormity of this waste and the necessity for conserving our coal supply have apparently not fully dawned on the consciousness of our Congressmen.

France, since 1914, although at war, when faced with coal shortage and the necessity for power, has managed to find the means and men to increase her developed water powers, especially those in the Alpine and Pyrenees sections. From a total of 1173 generating systems, of which only seven developed more than 10,000 hp., the industry jumped during 1915 and 1916 to more than 5,000,000 hp., with several establishments producing more than 40,000 hp. and one even reaching 250,000 hp. France's electrochemical and electrometallurgical processes have also been stimulated by the hydroelectric development of the war, and if with the return of peace the possibilities

of the French Alpine water powers are carried to the highest development, at least 15,000,000,000 kw.-hr. a year can be produced, which would be equivalent to thirty times the total coal production of the basin of Lens. Our potential water powers are greater than those of France, and the prompt necessity for utilizing them is plainly apparent. Moreover, prompt development would bring about a partial solution of the labor problems of the country.

The motor-driven device that can be sold and forever forgotten by the seller has not yet been made. With each device must go a certain portion of service if it is to give satisfaction and withstand long use. It seems, therefore, that mature judgment should prevent the making of undue claims in public assertions regarding appliances.

Vibration in Turbo-Alternators

MODERN mechanical and electrical engineering are tending toward the utilization of materials not merely for maximum safe working stresses but also for maximum safe rotary speeds. In order to secure safe rotary speeds with large angular velocities, it is necessary to obtain carefully adjusted dynamical balance of the rotor. Much more attention has been devoted to the balance of rotary parts in the last ten years than was formerly necessary.

In order that a rotating disk shall remain balanced at all safe speeds it is necessary not only that it shall be statically balanced—*i.e.*, that its mass center shall be on the shaft axis—but also that the disk shall be homogeneous and truly circular. A disk may be in correct static balance and yet if it contains cavities or is non-homogeneous, it may be out of balance when rotated. In such a case a certain mass, secured at a particular place on the disk, may compensate for the irregularity and restore the dynamic balance at the particular speed of rotation. As a general rule, however, it will not be correctly balanced for other speeds. The compensation for lack of symmetry in the disk will vary from one speed to another, so that a compensated disk which may run truly at a high speed of rotation will probably be somewhat out of balance at lower speeds.

In a long cylindrical rotor the conditions are still more complex. The rotor may be in static balance, but if dissymmetries exist in various transverse planes, a corresponding set of radial forces will be established in these planes during rotation. Although it may be possible practically to compensate for the irregularities at rated speed by fastening a single mass at some most advantageous spot on the rotor's surface, yet, in general, only an approximation is possible, and a true compensation at one speed calls for a plurality of added masses.

The article by E. V. Amy in this number deals with this interesting and important subject of dynamic balancing in relation to turbo-generators. In these machines the turbine parts of the rotor can ordinarily be balanced without difficulty owing to the symmetry of the construction. The generator portions of the rotor are much harder to balance correctly at speed owing to the difficulty of applying the windings in a truly symmetrical way. Nevertheless, a good dynamic balance is of great importance and has to be arrived at by applying or removing compensating masses. The methods employed in this adjustment are of great interest to the operating engineer.

Some Details of European Practice

LARGE transmission work has progressed so far and so fast in this country that we have comparatively little to learn from European practice, delayed as it has been by five years of hostilities. There are, however, details of equipment abroad which are decidedly instructive, and some of these were mustered in the article by S. Q. Hayes in the last issue. In Europe as here protection against lightning is one of the serious problems of transmission work, but while protective apparatus here has to a considerable extent become standardized, a wide variety of devices are there in common use. Electrolytic lightning arresters are seldom found in European plants, although they are beginning to appear as a result of American example. The two forms most common are the horn gap, familiar to every one, sometimes with liquid resistance, and, particularly, water jets, which serve efficiently to prevent dangerous rises of voltage from whatever cause. The scheme is a very simple one, being merely a jet squirted from a grounded water pipe against a plate connected to the line. This jet is so adjusted as to produce a constant leakage of 0.1 amp. to 0.2 amp., which is found sufficient for the purpose. On a 20,000-volt line the jet may be approximately ½ in. to ⅝ in. (12.5 mm. to 15 mm.) in diameter and 12 in. to 15 in. (30 cm. to 38 cm.) long, which with water of ordinary purity seems to meet the conditions. For other voltages the dimensions obviously have to be varied. An ammeter and a disconnecting switch are commonly found in the discharge path. Occasionally a path for the static is furnished by condensers, although this is perhaps less common than the water jet. Both devices seem to work well, although there is no reason to suppose they are practically more effective than those found in American usage.

Switchboards in European plants will be found to show an exceptionally large variety. Many of them follow American designs with minor modifications, and the tendency to take advantage of our experience is naturally very conspicuous. Control pedestals convenient to the generators are much more common abroad than here, very probably owing to the moderate size of most European plants compared with large American stations. An interesting construction practically unknown in this country is the truck-type board, in which all the instruments and operating devices are mounted on a wheeled frame backed up into connection with the busbar and cable system. In some cases the former is planted against the wall of the generator room with its connections reaching into a switch room beyond. When repairs are necessary and the unit is cut clear of the system, the whole working part of the board can be pulled out and rolled away for inspection or repairs and a spare wagon can be backed into its place. In transformer design special prominence is given to the core type on account of the facility and speed of repairs and replacements.

Taking a general view, however, the experience of American makers in large high-voltage units is so much richer than that of European engineers at the present time that we have comparatively little to learn from them. Some admirable transformers are made, however, abroad, and Mr. Hayes cites some tests of recent transformers which are remarkably satisfactory, especially in point of efficiency. On the whole, the American apparatus is much more thoroughly standardized than that found abroad, and it is rather in details than in general methods that European practice can be profitably studied.

Airing Family Skeletons

THERE are what might be called two schools of washing-machine salesmanship in the electrical merchandising field. One believes that the proper way to sell washers is to make the list price as low as possible while still permitting the earning of a fair profit for the manufacturer and the retailer. The other is convinced that more machines can be sold by making the list price high enough to permit the offering of a premium with each washing machine purchased. Arguments for and against these plans have been advanced in trade conventions and in such other places as are usually provided for the discussion of electrical trade problems, with little success as regards a practical solution. The whole matter as far as the electrical merchandising field is concerned is a family affair that should be settled inside the family. It is not one that can be argued on a competitive basis with the public sitting as the judge. In this as in all instances where trade problems are involved it is advisable in the long run to discuss the whys and wherefores within the trade and to let all energy expended on the public take the form of constructive selling.

Foremen must be trained to carry out the ideas of broad-gaged managers if good relations between corporate executive officers and employees as a body are to attain full fruition. The sergeants and lieutenants of industry have a responsibility little realized by outsiders in carrying the policy of the square deal over the intrenchments of prejudice and suspicion. The work of these subordinate leaders must pass the audit of their superiors and should not be left unchecked until the belief of the employees in the just intentions of those "higher up" has gone bankrupt.

Preserving Transformer Oil

TRADITION hath it that oil and water will not mix. Nevertheless they do, sometimes, with most malign results, and likewise the transformer oil, which takes water from the air, also, if hot, takes up oxygen and grows dark and muddy. No one minds the change of color, but the sludge chokes the core and coil flues and up goes the temperature to help in burning more sludge. Time effects in chemical reactions are often of a most curious and striking character, and long-continued moderate heat in the presence of air seems to break down compounds that are ostensibly very stable, like paraffine oils. Whether the molecules in the presence of oxygen are really, when moderately heated, somewhat less stable than they ordinarily seem, or whether traces of impurities act as catalysts, is not certainly known, but the general deterioration is familiar and in transformers for high voltage not infrequently troublesome.

In a recent paper by W. S. Moody is described a very simple and effective method of dealing with these difficulties. It consists, in brief, of connecting to the top of the transformer case proper a small expansion tank, so that the case is at all times full of oil and the only place at which the oil supply is in contact with the air is at the oil level in the tank. This is provided with an oil gage and with a breathing tube filled with calcium chloride to keep dry the air taken in under differences of temperature. The result is that there is no longer any considerable surface of oil exposed to the air, even dry air; the oil level never gets low enough to expose the coils or otherwise imperil the insulation within the case; the access of moisture is prevented, and the oil is permanent even under long exposure to the highest working temperatures. Particularly, the absence of sludge helps the effective cooling, while the still oil in the tank does not enter the general circulation, is therefore not much above air temperature and is very unlikely to show signs of alteration.

Few greater mistakes can be made in modern manufacturing than to slam the door in the face of natural curiosity as to the workings of departments on the part of new or transferred employees. Interest is a factor in stimulating production which is often undervalued.

Some Larger Aspects of Power Transmission

FREDERICK DARLINGTON contributed to our columns last week a thoughtful study of that centralization of power production toward which practice has been steadily working in recent years. Mr. Darlington was one of the engineers engaged in the investigation of the whole power situation at the instance of the War Industries Board and had wide opportunity for co-ordinating the data in their bearing upon a general scheme of distribution. It became apparent that central-station development has already reached a point where there is necessity for great interconnected systems covering interstate areas. Such systems must naturally be fed by the most convenient and efficient means, steam or water as the case may be.

Broadly, the country divides itself as regards its eastern part into four districts, one in New England, a second in eastern Pennsylvania and New Jersey, a third west of the Appalachian heights and reaching into Ohio, and a fourth in the industrial part of the new South at the extreme southern end of the Appalachian chain. New York State is contiguous to the first two districts mentioned and can be reached from both of them. In each of these first two there is a total annual power production of approximately 6,000,000,000 kw.-hr. A little over a third of this quantity is produced by steam and water stations at reasonable efficiency. Better interconnection, and approximately double the present central-station production, is desirable in both territories. The other two regions likewise should be nearly doubled in large station capacity and more completely interconnected if anything like the proper efficiency is to be obtained.

There is nothing in carrying out such projects which involves material variations from present practice. It is only necessary to keep advancing in the addition of sources of output and in the completion and elaboration of networks, toward which a good beginning has already been made. Mr. Darlington does not go far into the plans for gigantic plants at the mine's mouth, using coking coals and producing other by-products than electricity, since there is plenty to be done along lines already familiar while these larger plans are undergoing orderly development. He points out the need of co-ordination of our national and state laws to the end that these necessary interstate projects should be brought to fulfillment. At present the rulings of commissions, water-power laws and anti-trust laws put the brakes on development, so that we are still, to our sorrow, terribly dependent on the mining and transportation now imperiled by widespread unrest.

Ventilation of Induction Motors

In High-Speed Machinery the Tendency Is Toward Relatively Small Diameters and Long Lengths—To Cool an Induction Motor of Fairly Large Capacity Properly It Is Necessary to Force Large Quantities of Air Through the Machine

BY FRASER JEFFREY
Electrical Department, Allis-Chalmers Manufacturing Company

WITHIN recent years there has been an ever-increasing demand for induction motors of fairly large output and relatively high speed for use principally with centrifugal pumps. This application has generally called for 60-cycle units with synchronous speeds of 1800 and 1200 r.p.m. and for 25-cycle units with synchronous speeds of 1500 r.p.m., thus involving the use of four-pole, six-pole and two-pole motors respectively.

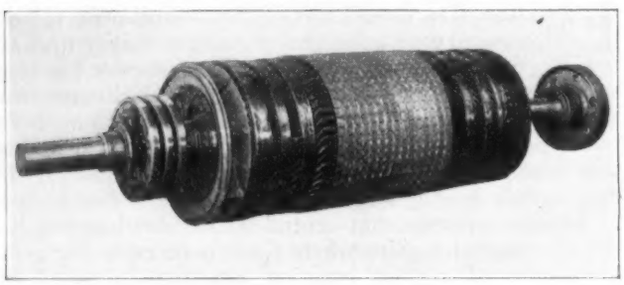


FIG. 1—ROTOR OF TWO-POLE 25-CYCLE, 1500-SYNCHRONOUS R.P.M. MOTOR

While the speeds are not so high and the outputs not so great as those encountered in turbo-generator practice, the tendency seems to point to larger capacities at these particular speeds. There seems to be little call at the present time for two-pole, 60-cycle, 3600-synchronous-r.p.m. machines, as the development of the centrifugal pump for this high speed has not been deemed practicable, and the use of such high-speed motors with reduction gears will, if anything, show a higher first cost without any better operating characteristics than an 1800-synchronous-r.p.m. direct-connected unit.

are of necessity of small diameter and relatively long length. In such machines, using a construction where the coils in the rotating element are held by overhung slot tips and by banding wire. the highest peripheral speed deemed practicable at this time is about 12,000 ft. (3600 m.) per minute, a more conservative figure being 10,000 ft. (3000 m.) per minute. In the regular turbo-type of generator, having the coils in the rotating element held in place by metal wedges and steel retaining rings, the peripheral speed is run as high as 26,000 ft. (7800 m.) per minute. However, the use of steel retaining rings for holding the ends of the rotor coils of induction motors is not deemed practicable on account of the excessive leakages that would be incurred. A practically non-magnetic material combining low permeability and high mechanical strength might be used, but, inasmuch as the strength of this material is lower than that of a high-grade steel, the peripheral speed of a rotor constructed in this manner would have to be lower than if it were possible to use steel rings. This means that for any given high-speed rating the induction motor probably will be of smaller diameter and greater length than a turbo-generator where the stressed parts can be worked at higher values.

It is then seen that the outstanding characteristics of high-speed machinery are small diameter and long length. If the unit is of fairly large capacity, it is usually made totally inclosed to prevent the air action through the machine from being objectionable from a noise standpoint, and also to be able more effectively to control and use the air as a ventilating medium. It has been found necessary to resort to some means of forcing air for cooling purposes through these types of machines, and it is readily

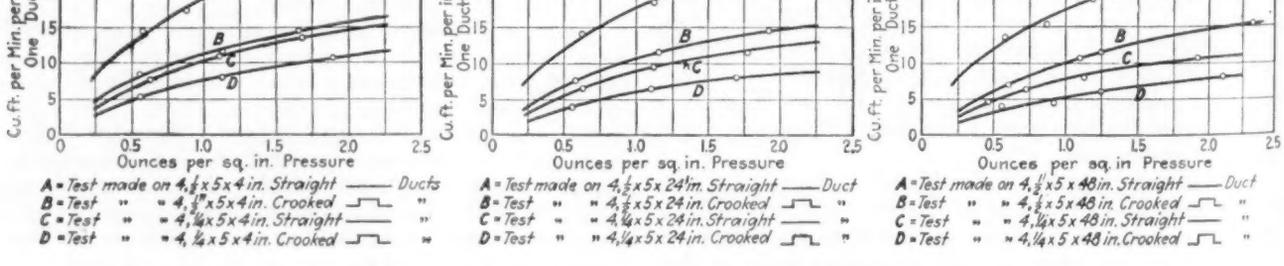

Cu. ft. per Min. per in. Width per One Duct
Ounces per sq. in. Pressure
A = Test made on 4, ½ x 5 x 4 in. Straight —— Ducts
B = Test " " 4, ½ x 5 x 4 in. Crooked — "
C = Test " " 4, ¼ x 5 x 4 in. Straight —— "
D = Test " " 4, ¼ x 5 x 4 in. Crooked — "
A = Test made on 4, ½ x 5 x 24 in. Straight —— Duct
B = Test " " 4, ½ x 5 x 24 in. Crooked — "
C = Test " " 4, ¼ x 5 x 24 in. Straight —— "
D = Test " " 4, ¼ x 5 x 24 in. Crooked — "
A = Test made on 4, ½ x 5 x 48 in. Straight —— Duct
B = Test " " 4, ½ x 5 x 48 in. Crooked — "
C = Test " " 4, ¼ x 5 x 48 in. Straight —— "
D = Test " " 4, ¼ x 5 x 48 in. Crooked — "

FIG. 2, 3 AND 4—FLOW OF THE AIR THROUGH DUCTS

In the development of any particular machine, the speed at once sets a maximum as to the permissible diameter of the rotating element due to the mechanical limitations of the materials used. As this dimension is then fixed, it is evident that large-output, high-speed machines

seen that the ordinary methods of construction and ventilation will be inadequate, for the reason that the air at the center of long machines will not tend to circulate, with the natural result that the nearby parts will heat to a dangerous extent.

Measurement of Hot-Spot Temperature

It is not correct to estimate a safe working temperature as that which could be measured by a thermometer placed on the ends of the coils. Neither is it correct to set a limit as to the rise that could be measured by taking the hot resistance of the coils. This is readily understood because that part of the coil which is embedded in the

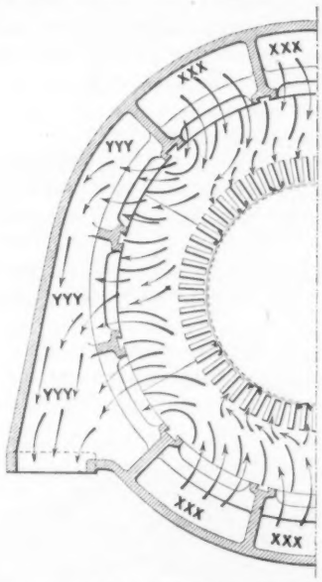


Fig. 5—Vertical cross-section through two-pole 25-cycle, 1500-synchronous r.p.m. motor

iron is necessarily hotter than that part which is free to all cool-air currents, and again, the rise-by-resistance method is taken over the range of the whole coil or groups of coils and gives an average rise which by no means indicates what the temperature in the hottest part of the coil might be.

In considering the temperature it should be borne in mnid that the results as obtained by the above methods do not necessarily indicate the true temperature rise. The true hot-spot temperature rise might be characterized as "the weak link in the chain," or the rise in the hottest part, which is the limitation of all other parts. It is customary on the larger machines to use resistance coils or thermocouples placed between the upper and lower

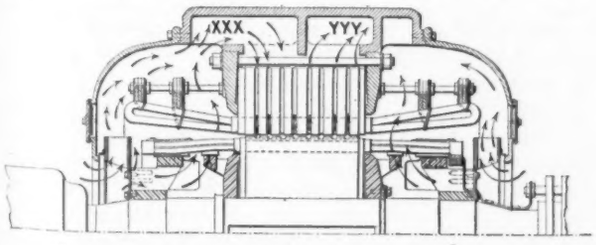


Fig. 6—Longitudinal section of design in fig. 5

coils in the center of the slot portion of the machine which record temperature on a direct-reading instrument. It is generally agreed that resistance coils and thermocouples so placed will show with the added allowances recommended by the American Institute of Electrical Engineers the maximum obtainable hot-spot temperature.

Special methods of ventilation have been found necessary, and in some cases a construction that is satisfactory for one type will not do for another type unless radical modifications are made in the mechanical and electrical designs to suit each particular case in question. In order to avoid the danger of hot spots in the core and of dangerous heating in that part of the coil which is embedded in the iron, the high-speed machine is usually made with a great many duct or vent passages and a sectionalized core such that the coil will not be embedded in any one length of core which is too great. In addition to this it is necessary to ventilate the center of the machine just as well as the ends, and this involves a more or less specially constructed motor.

If a machine is properly ventilated, it will require from 100 cu. ft. to 150 cu. ft. (2.8 cu. m. to 4.2 cu. m.) of air per minute per kilowatt internal loss, depending on the size, exact type and construction in question. This has been determined largely from actual tests made on various machines and taking into consideration whether or not the rating is on a 50 deg. C. rise continuous basis or on a 40 deg. and 50 deg. C. rise basis. As the specific heat of air, which is practically constant over wide variations in temperature, equals 0.237 and 1 lb. (0.45 kg.)

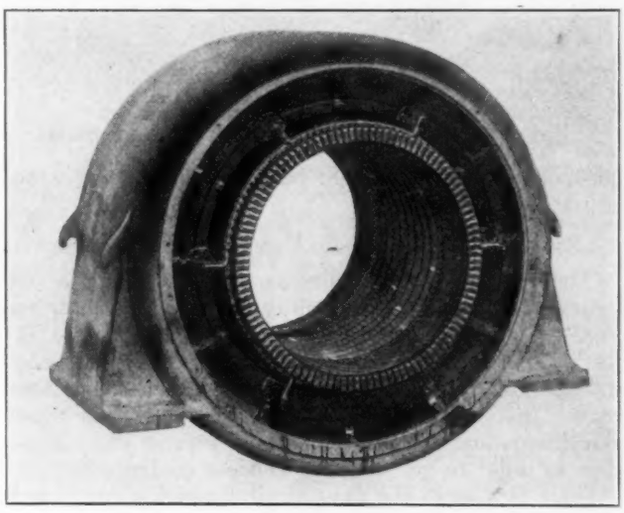


Fig. 7—Completed stator of six-pole, 60-cycle, 1200-synchronous-r.p.m. motor, showing air-inlet passageways

of dry air at 32 deg. Fahr. (0 deg. C.) at sea level contains 12.4 cu. ft. (0.3 cu. m.), it follows that the theoretical average rise in degrees C. equals 1.65 W divided by V, where W equals watts loss and V cubic feet of air per minute.

In the use of this formula it should be borne in mind that the windage loss must be taken into account, while it is logical to assume that the bearing friction can be excluded, as the resulting heat can be taken care of by the lubricating system. It is most important, however, to include the windage loss, for in the high-speed type of machine this not only is a large percentage of the total loss but actually creates more heat than one might be led to expect. By belting a high-speed motor to a driving motor and running the former without any excitation the windage loss alone will in some cases create a rise in temperature as much as 10 deg. C.

Tests often show that it takes more power to drive the

high-speed motor without the fans on the rotor than with them. This is due to the pocketing of the air and the skin-friction effects of the rotor and shows the importance and necessity of correct air-duct design in order to minimize these particular losses. The value determined by the previous formula is the theoretical average temperature rise and by no means indicates what the various

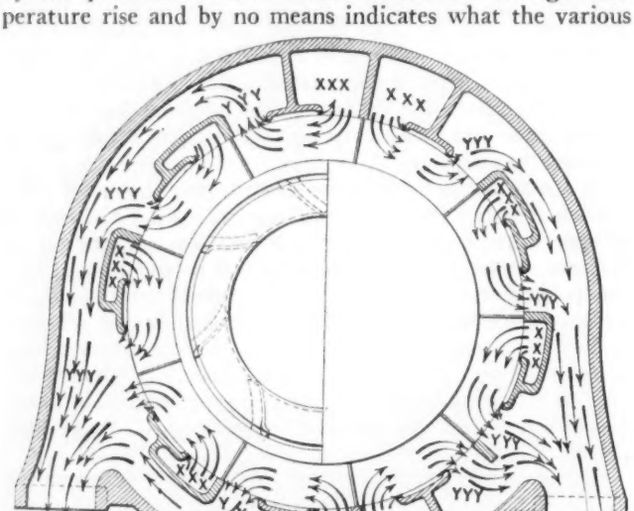


FIG. 8—AIR CIRCULATION IN SIX-POLE MOTOR

hot-spot temperatures might be. For this reason it must be used with discretion.

EFFECT OF SHAPES OF VENTILATING PASSAGES

The cooling air is usually supplied by means of two separate fans, one mounted on each end of the rotor (see Fig. 1), and all air passages must be so arranged that the friction loss will be as small as possible. It is essential that all passages have gradual rather than sharp curves, that the velocities in them be kept within reasonable limits, and that the lengths be kept as short as possible in order to get the most efficient cooling effect.

Some idea as to the flow of air through ducts may be obtained by an inspection of Figs. 2, 3 and 4. In all cases the tests were made on four ducts, some being ¼ in. (6.4 mm.) wide, others being ½ in. (12.8 m.) wide, all

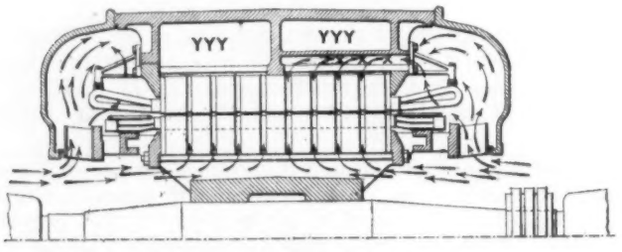


FIG. 9—LONGITUDINAL SECTION OF SIX-POLE MOTOR, DESIGN SHOWN IN FIG. 8

being 5 in. (12.9 cm.) high, and in the various lengths and shapes as noted. All the curves have been plotted on the basis of the flow of air through one duct either ¼ in. or ½ in. wide and 1 in. (2.5 cm.) high, thus averaging the tests as made on four ducts and plotting the ordinates in values for the one duct only. As indicated, some of the ducts had a straight flow throughout the entire length, whereas others had four sharp right-angled bends. The first type has been designated as "straight duct" and the second as "crooked duct." The outstanding features of these tests show that while the length of the passageway does not have any great effect on the amount of air passed, the effect of sharp turns or crooks produces a most pronounced change; that when the area of the passageway is cut in two the volume of air passed for any given pressure is practically halved for the straight duct but not for the crooked duct, and that when the pressure is halved the volume of air passed is not necessarily halved.

In the ordinary high-speed machine it is considered reasonable practice to limit the air velocities in the small duct passages to not over 3000 ft. (900 m.) per minute, while in the larger passageways it is well to avoid a velocity of much over 2000 ft (600 m.) per minute. In the passageways leading to and from the motor a velocity of 1500 ft. (450 m.) per minute easily can be provided for.

In the design of a machine to meet these requirements it is necessary that the total volume of air required can pass efficiently and quickly through the machine. In order

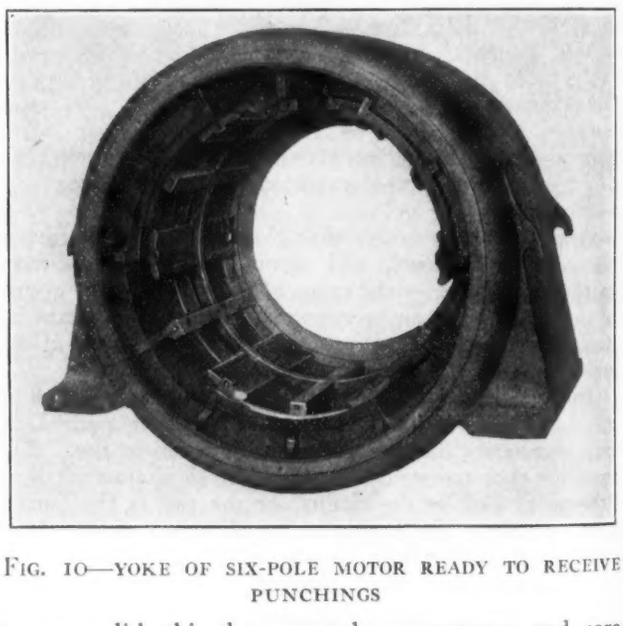


FIG. 10—YOKE OF SIX-POLE MOTOR READY TO RECEIVE PUNCHINGS

to accomplish this there must be passageways and core ducts of reasonably short lengths and of such areas that the total air volume can be passed readily with velocities not exceeding the limits given above. In this connection it is well to notice that the greatest amount of air is in the stator and that the greater part of the cooling air is required for it. As the rotor loss is comparatively small and as little can be done toward ventilating the rotor core, it is usually made without ventilating ducts except for grooves turned on the periphery opposite each stator ventilating duct, as in Fig. 1. The heat due to losses is dissipated readily on the surface of the rotor while the ends of the coils create a fan action themselves sufficient for the proper cooling effect.

A two pole, 25-cycle, 1500-synchronous-r.p.m. motor, the flow of air being shown by Figs. 5 and 6, is easier to cool than a six-pole, 60-cycle, 1200-synchronous-r.p.m. motor, if the same scheme of ventilation and the usual

electrical design is adhered to in each case. In the arrangement shown by Figs. 5 and 6 the air is taken in at each end of the machine by the fans on the rotor, which establish an air pressure in the chamber directly above them. Part of the cooling air passes between the ends of the stator coils; a slight amount passes through the air gap and up through the stator vent ducts, and the remainder, with that which passes through the ends of the stator coils, is introduced behind the core in the inlets marked *XXX*. From these chambers the air passes through the curved-vent ducts in the core to the outlets marked *YYY*, thence on out through the feet of the motor to the air-outlet passageways. Fig. 7 shows a completed stator and the air-inlet passageways *XXX*. This method of ventilation is such that the air travels in parallel paths, through short passageways. As a result efficient cooling is obtained.

A six-pole, 60-cycle, 1200-synchronous-r.p.m. motor presents a somewhat different problem of ventilation from that of the two-pole, 25-cycle, 1500-synchronous-r.p.m. machine. In the latter there is an inherently great depth of core back of the stator teeth, so that by a reasonable sectionalizing of the core and arrangements of parallel air paths there is enough core-duct area to take care of the full amount of the cooling air without undue velocities. In the former type, however, the depth of the stator core back of the teeth is relatively small, when compared to the two-pole motor, and such that an impracticable number of parallel air passages and core ducts would be required to carry the necessary volume of cooling air. In order, then, to get the proper amount of air the number of parallel paths is increased, if feasible, and a certain amount of the air is allowed to pass from the inlet chambers *XXX* (Fig. 8) back of the stator punchings to the outlet chambers *YYY*, the rest of the air passing through the curved-vent ducts as indicated and in the same manner as for the two-pole machine. The longitudinal section of this same scheme is shown by Fig. 9, while Fig. 10 shows the yoke of such a machine ready to receive the punchings. This affords a good means of cooling, as the relatively large amount of air passing back of the punchings is really more effective in conducting the heat away from the laminations than that passing through the core ducts.

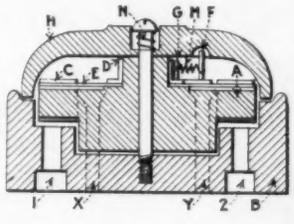
The immense amount of air passed by a ventilated machine is not often fully realized, and it is interesting to follow out some figures in respect to such a type of motor. Considering a 1000-hp. motor at 1200 synchronous r.p.m., if it is estimated that the total internal loss, excluding bearing friction, equals 35,000 watts, and that for the given temperature limits 125 cu. ft. (2.5 cu. m.) of air per minute per kilowatt internal loss is required, the motor will have to pass $35 \times 125 = 4375$ cu. ft. (122.5 cu. m.) of air per minute, or $4375 \div 12.4 = 353$ lb. (160 kg.) of air per minute, or $(353 \times 60) \div 2000 = 10.6$ tons of air per hour. This is a large amount of air and brings up other questions beyond the scope of this article, such as the extreme importance of supplying, by various methods such as screen filtering and scrubbing, the air to the machine in a cool, clean condition; the feasibility of utilizing this large volume of warm air for heating purposes rather than exhausting directly to the atmosphere, and the importance of insuring that all ventilated machines should be periodically cleaned out by removing the end bells and rotor and blowing out the accumulations of dust and dirt, bound to collect, by the use of air-pressure hose.

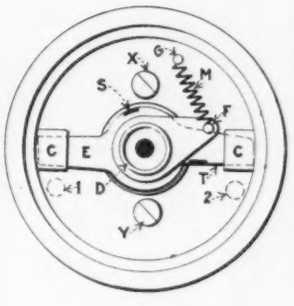
TERMINAL SCREWS AND KNOBS ELIMINATED IN NEW SWITCH

Device Invented in England Can Be Easily Installed and Is Not Likely to Become Faulty from Continuous Operation

Binding screws, knobs and handles are completely eliminated in the switch recently invented by Charles W. Smith of Kingston-on-Thames, England, according to an item in the Oct. 16 issue of the *Electrical Times* (London). The switch is simple in construction, having a minimum number of parts, and is operated by merely turning the small round cover to the right or to the left. To connect it in the circuit the ends of the wire are laid between contact plates and a false base, the necessary contact being accomplished by the pressing of the wire against the contact plates when the two wood screws are tightened.

Details of New Switch Design



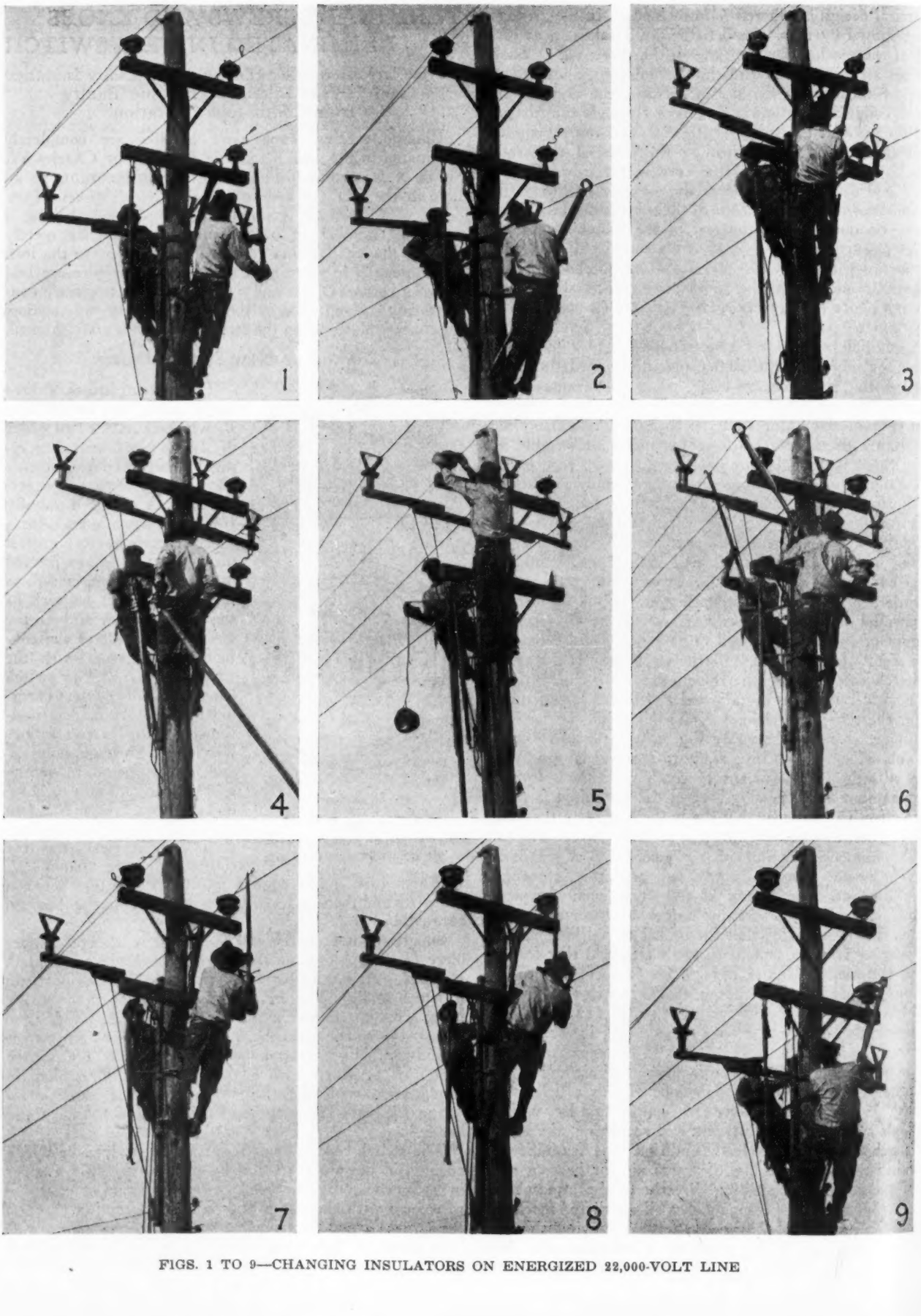


SWITCH IS OPERATED BY TURNING THE COVER

The switch consists of three major parts, the switch base *B*, which is recessed in order to carry the contact-carrying block *A* and the outside cover *H*. The contact-carrying block A is slotted radially from the circumference for a short distance to receive metal pieces *C*, which are pressed into the slot and serve to form the contact on each of the circuit wires and at the same time to act as the contact-making pieces with the switch arm *E*. The switch base *B* and the contact-carrying block *A* are held in position by means of two screws which pass through holes *X* and *Y* in *A* and in switch base *B*. In addition to holding the switch base *B* on to the wall or other surface, these two screws press the contact-carrying block *A*, which in turn makes a good and secure contact between the wires and the contact pieces, as indicated in the diagram herewith.

Superinmposed on the switch arm *E* is a metal trigger piece *D*, also pivoted on the central portion of the contact block *A*. At one end of this trigger is fixed a short pin to which spring *M* is attached, the other end of the spring being fixed to another pin *G* in the block *A*. This is so adjusted as to compress the spring when the switch arm *E* is midway between the on and off position. The switch arm *E* is provided with two stops *S* and *T*, which, in combination with the trigger piece *D* and the control spring *M*, serve the purpose of giving a quick "make and break."

The switch cover *H* has a slot on the under side which engages in the pin *F* so that by turning the switch cover in a clockwise or counter-clockwise direction it causes it to engage with the pin *F* and so imparts motion through the spring *M* and the trigger piece *D* to the switch arm *E*. The screw *N* holds the switch cover on to the switch base *B*.



FIGS. 1 TO 9—CHANGING INSULATORS ON ENERGIZED 22,000-VOLT LINE

Changing Insulators on Live Lines

Insulating Frame Used to Raise and Hold High-Tension Line Conductors Above the Top of the Pole So that Insulators and Cross-Arms Can Be Replaced with Ease—Lifting Tools and Other Devices Aid in Tying the Wires to the Insulators

SUDDEN insulator failures on a 25-mile (40-km.), 22,000-volt transmission line built about five years ago caused a central station in northeastern Pennsylvania to give prompt attention to inspecting and determining the reasons for the trouble. This line, which serves a near-by city, runs through a hilly country and the region is particularly noted for its frequent and violent lightning storms. Of course, the severest insulator failure occurred on the poles on the tops of the hills, but soon the whole line became affected and immediate steps had to be taken to avert serious trouble without interrupting service to consumers at the distant city.

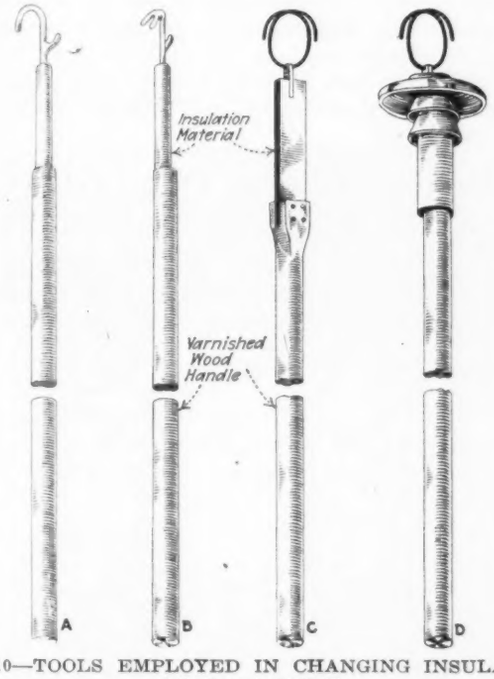


FIG. 10—TOOLS EMPLOYED IN CHANGING INSULATORS ON LIVE LINES

A, tying wrench; B, untying wrench; C, lifting tool; D, cleaning tool.

Instead of waiting until the insulator failures manifested themselves and caused considerable inconvenience to industrial plants served, the superintendent picked three of the best men in his line gang and instructed them in detecting bad insulators on a "live" line and in changing them when the seriousness of the trouble necessitated this action. Apparatus was obtained which allowed the men to work on live lines without danger. A horse and wagon were procured to transport the apparatus. The three men started from one end of the line and traveled to the other, stopping at each pole. If they heard a buzzing sound, they knew that the insulator was defective and stopped to investigate. Before climbing any pole one of the men tested it with a telephone receiver to determine how much current was leaking to the ground. To be assured that this leaking current was not a source of danger to him the potential drop was tested every 6 ft. (1.8 m.). After changing the insulators or cross-arms, according to whatever was necessary, the men drove on to the next pole. When they got to the end of the line they turned around and started back over the same route. At night they erected a tent wherever they happened to be and stayed for the night. This has proved to be a better method than allowing the men to go back to town each night as considerable time is saved and regular inspection assured.

FIG. 11—TIE WIRE ARRANGED ON INSULATOR SO IT WILL NOT BE A MENACE; ALSO IN POSITION TO BE TIED TO CONDUCTOR

The work of changing insulators is accomplished in the main by means of Cronin tools mounted on long poles as shown in Fig. 10. Tool *A* is used for tying the conductor to the insulator when the insulator is equipped with a tie wire (Fig. 11). This tie wire is made of two pieces of wire, the same size as the line conductor, and is attached to the pin insulator before it is mounted on the cross-arm. The two hooks on the tying wrench make it easy to tie the conductor firmly to the insulator in a few minutes. When an ordinary tie wire is employed the tying wrench illustrated at *B* in Fig. 10 is used. The tie wire can be gripped in the claw of this tool no matter how tightly it is clinched. After the conductor is set free it can be lifted from the insulator and held away while the insulator is changed. Where an insulator is defective and new ones are not available, the clearing tool shown at *D* in Fig. 10 can be fastened to the conductor and clamped to the pole. It consists of an insulator mounted on a pole and is used as an insulator in an emergency.

When cross-arms need replacing, or when it is desired to change all the insulators at the same time, the men use the "strong man" pictured in Fig. 12. The use of this frame, which allows the raising of the wires above the top of the pole, can best be depicted by a description of the actual change-over shown in Figs. 1 to 9, which was made recently.

In Fig. 1 two men are shown on the pole with the

FIGS. 1 TO 9—CHANGING INSULATORS ON 22,000-VOLT LINE

The process of changing the insulators is as follows: In Fig. 1 the wire is being removed on one side with the untying wrench while being held on the other side with the lifting tool; in Fig. 2 the wire is being placed in the wire-holder; in Fig. 3 another conductor is being untied; in Fig. 4 the three conductors are being raised above the cross-arms; in Fig. 5 the old insulators are being replaced; in Fig. 6 the conductor is being put back on the insulator; in Fig. 7 the line man is pushing the tie wire over the line wire with the tying wrench; in Fig. 8 he has hooked the loop of the tie wire and is pulling it tight over the wire; in Fig. 9 the tying process is again illustrated.

"strong man" tied to the pole just below the cross-arm. The lineman on the opposite side of the pole is holding one of the conductors with the lifting tool and the other man is removing the insulator with the untying wrench. When one side is untied the men change tools and then work on the other side. By holding the conductor with the lifting tool, the workman prevents the wire from sliding off the insulator when the tie wire is loosened and reduces the probability of danger if the conductor should accidentally break. Fig. 2 shows the conductor completely untied and being transferred from the insulator to the fiber receptacle on the "strong man." The frame is now raised by means of the pulley and rope arrangement so that the middle wire holder is silghtly above the top cross-arm. Then the conductor nearest this holder is loosened from its insulator and placed in position. In order to provide the proper clearance, the third wire holder is extended to the left of the pole. Fig. 4 shows the three conductors in their respective positions on the frame and raised so as to clear the cross-arms and be out of possible reach of the men. If it is desired, the entire cross-arm can be replaced. Fig. 5 shows one lineman pulling up a new insulator, which is tied to the rope by the ground man, and shows the other lineman removing an old insulator from its pin. In handling the insulators the tie wires are bent as shown on the insulator on the left of Fig. 11 to avoid accidental contact with the live conductors. After the insulator is placed on the cross-arm, however, the tie wire is bent down to be ready for tying as shown in the other insulator illustrated in Fig. 11.

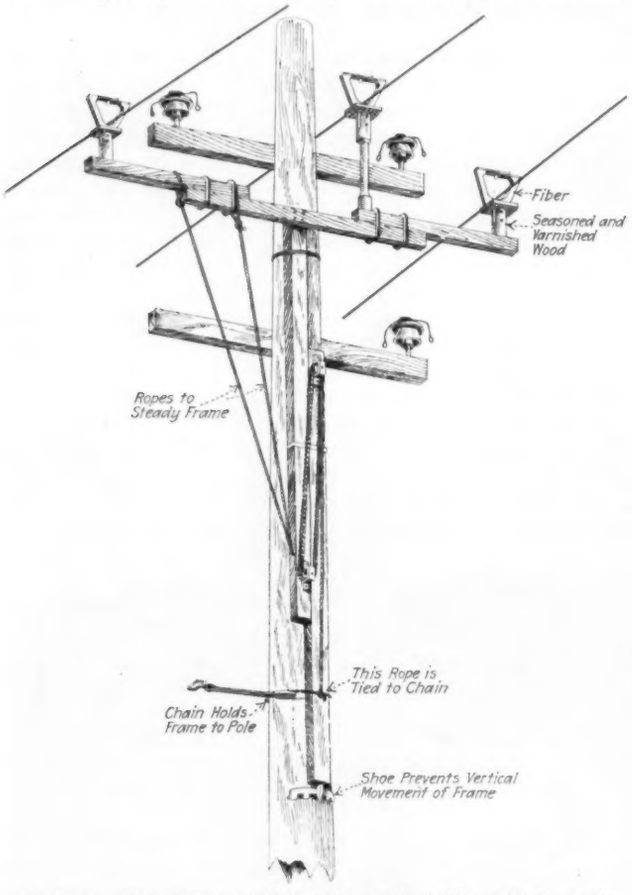

Fiber
Seasoned and Varnished Wood
Ropes to Steady Frame
This Rope is Tied to Chain
Chain Holds Frame to Pole
Shoe Prevents Vertical Movement of Frame

FIG. 12—"STRONG MAN" FOR HOLDING LINE CONDUCTORS WHILE CHANGING INSULATORS AND CROSS-ARMS

This frame is tied to the pole in such a manner that the top part can be raised by means of a rope and pulley. Ropes on the side steady the frame and prevent it from tipping.

After the insulators have been replaced the wire is lifted (Fig. 6) from the holder back to its position in the groove of the insulator, one man using a lifting tool and the other holding the wire with a tying wrench. Figs. 7, 8 and 9 show in detail the ease with which the wire is again tied to the insulator. One lineman holds the conductor tightly in the insulator groove while the other man pushes the tie wire over the line conductor with the tying wrench and then, reaching around the conductor, hooks the loop of the tie wire and pulls it down with considerable force. This process is repeated until the tie wire is twisted firmly around the conductor. Fig. 9 shows how the conductor is held in place by one man while the other makes the tie on his side.

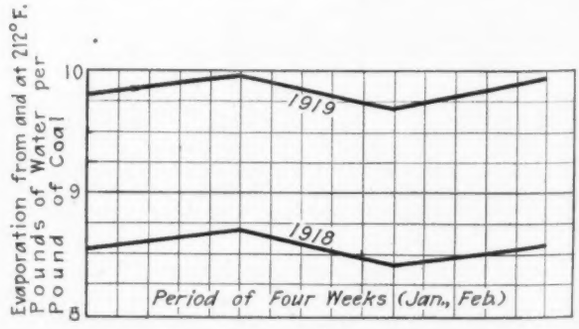
While working on the pole the men can easily maintain their position by using their belts. The process, as shown, can be accomplished with ease in less than a half-hour, and once they become used to the work, the men show no fatigue after their labors. Rope loops are made on the cross-arm so that the tools not in use can be supported.

Enough wire holders are supplied with the outfit to work with six wires. The wire holders are mounted on pins and held in the holes on the horizontal arm by means of through bolts.

EFFECT OF LABOR AND LOAD ON BOILER EVAPORATION*

A Marked Improvement in Boiler Efficiency Was Obtained Within a Period of Two Months After the Armistice Was Signed

Owing to the large labor turnover and the inability successfully to train firemen during the war, central stations had considerable difficulty in operating equipment at its maximum efficiency. Repair work was withheld until it was absolutely necessary, so great was the demand on power plant. However, after the armistice was signed and the conditions became normal, an efficient boiler-room force could again be assembled.



CURVE SHOWING THE INCREASED BOILER EFFICIENCY AFTER THE ARMISTICE WAS SIGNED

The effect of this readjustment is shown in the accompanying curve of boiler evaporation for periods of four weeks in 1918 and 1919. The average pounds of water evaporated per pound of coal in January, 1918, was only about 8.5, whereas in January, 1919, it averaged 9.8.

* Excerpt from a paper entitled "The Effect of the War on Boiler-Room Practice" presented by John A. Barnard, Philadelphia Electric Company, before the convention of the Pennsylvania Electric Association on Sept. 3-6, 1919.

A Theory of Metallic Arc Welding*

Metal Said to Be Projected from Electrode by Suddenly Formed Vapors—Short Arc Concentrates Projected Particles Within Fluid Spot on Plate

BY RALPH G. HUDSON
Massachusetts Institute of Technology and Harvard University

IN THE summer of 1918 the welding committee of the Emergency Fleet Corporation initiated an investigation of metallic arc welding in which special attention was to be given to the determination of the cause and nature of the transmission of metal from an electrode to a plate. Although metallic arc welding had been employed successfully for a considerable period, it was appreciated that its application was based upon empirical methods, and to make greater use of such welding in shipbuilding it was evident that its basic principle should be investigated as thoroughly as possible so that inferior methods of metallic arc welding might be eliminated. The object of this paper is to present the results of an investigation of this character conducted in the laboratories of the Massachusetts Institute of Technology.

It should be noted that at the beginning of this investigation no satisfactory explanation had been given for the transmission of metal from electrode to plate. In downward welding the deposition of metal might be attributed to gravitational force, but in upward welding no such explanation could be offered. The fact that an electric current is employed in the process suggested the possible existence of forces of electrical origin which might pull metal from the electrode to the plate. Calculations of the magnitude of the electrical forces that may exist during metallic arc welding indicate that they are negligible and may therefore be eliminated as possible causes of the action. This view is further substantiated by the fact that satisfactory welding may be performed with current flowing in either direction or with alternating current, and that such differences as may exist with different directions of the current may be explained by consideration of the relative heating properties of such currents at the terminals of an electric arc.

In conducting this investigation the writer, following the suggestion of the committee, first attempted to obtain a photographic record of successive phases of the welding arc by means of a high-speed motion picture camera. Owing to the intense luminosity of the arc itself, however, the films thus exposed show only various shapes of the arc itself and an occasional view in silhouette of the electrode, molten drops and plate. The principal use made of these films was to examine them one by one with a low-power microscope with transmitted light, the observations being noted later.

Instantaneous photographs of the welding arc obtained with a short-exposure focal-plane shutter suffered from the same domination of the plate by the arc to the ex-

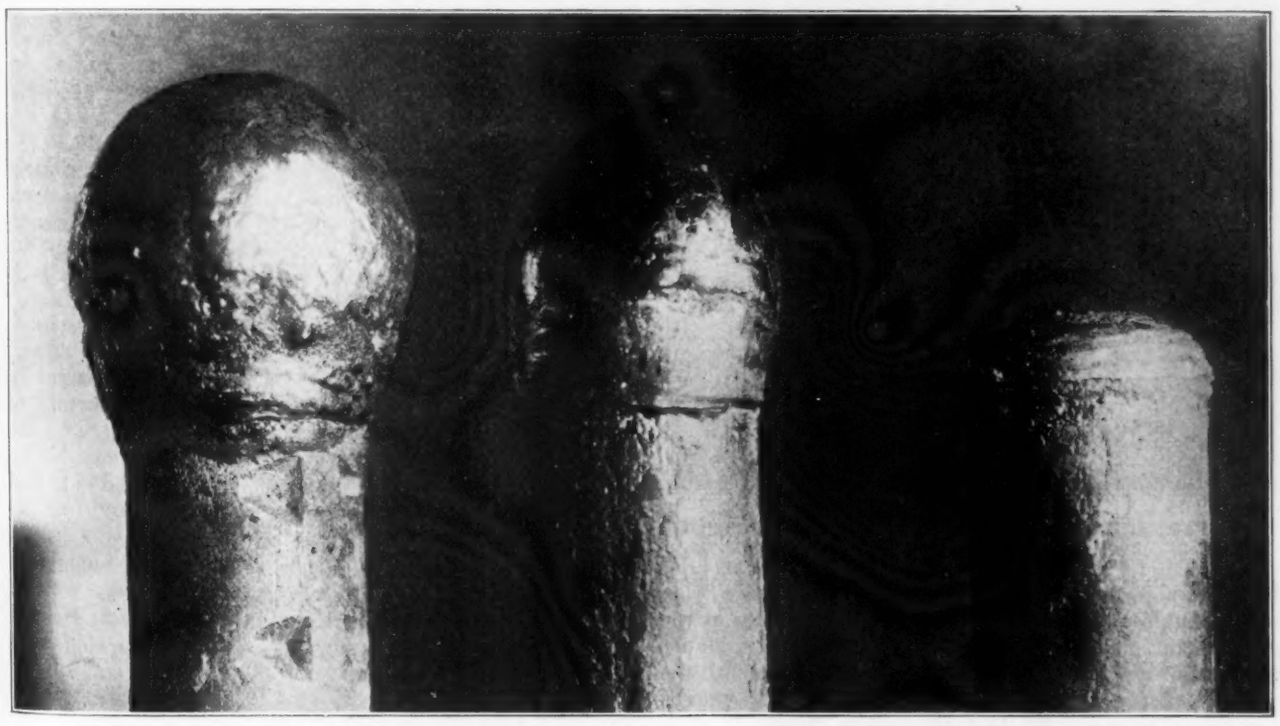


FIG. 1—EFFECT OF ARC LENGTH UPON SIZE OF ELECTRODE GLOBULE

At the right, a globule developed with a very short arc; in the middle, with a moderate length of arc; at the left, with a very long arc. These are $\frac{1}{8}$ in. electrodes magnified 6.8 diameters. The current strength in each case was 100 amp. Each globule contains a cavity; in the smaller globules, the cavities are usually open and resemble small drill holes, while in the larger ones they are usually closed and are surrounded by a thin skin of metal.

* Abstracted from paper presented before American Welding Society.

clusion of all other phenomena. While focusing the camera, however, it was realized that more could be seen with the eye on the ground glass than could be obtained photographically or by direct observation through dense glasses, so the writer began an extended study of metallic arc phenomena as seen in magnified form on the ground glass. In this manner the action of the arc could be examined without screening the eyes and with the further advantages offered by magnification and observation of the action in its true color.

When an arc is struck between a steel electrode and a steel plate the end of the electrode and a spot on the plate are heated to a high temperature and metal is transferred from the electrode to the plate. The electrode is heated to a higher temperature than the plate because the heating action of the arc is more concentrated in the case of the electrode and because the heat conduction away from the hot spot is greater in the case of the plate.

Since the melting points and other thermal constants of the elements* and their compounds found in steel electrodes vary widely and their chemical affinities are quite different, it is to be expected that the constituents of an

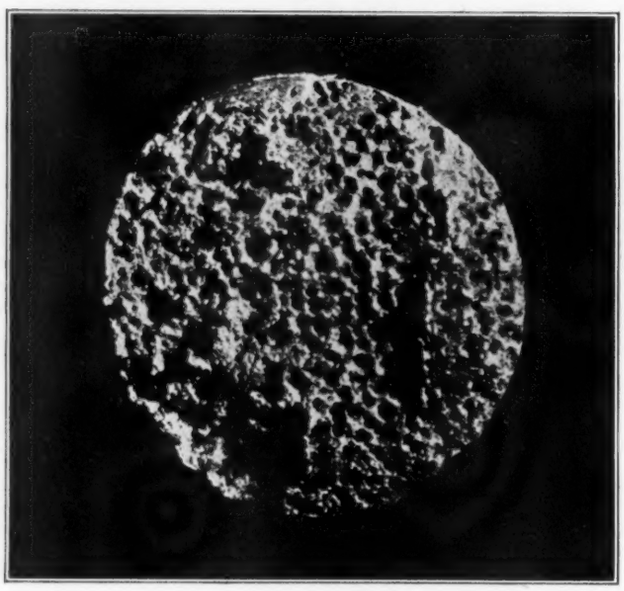


FIG. 2—SURFACE OF AN ELECTRODE ON THE ELECTRODE SIDE OF A LARGE GLOBULE

electrode subjected to a high temperature will change from solid to liquid or gaseous form successively and not at the same instant. Since the melting point of iron is higher than that of any other constituent of an electrode with the exception of carbon, which combines rapidly with oxygen at welding temperatures to form carbon monoxide, it is furthermore to be expected that in the welding process the iron constituent of the electrode will melt last.

The thermal changes just described are known to take place during the application of heat to any complex substance. In metallic arc welding the temperature changes which take place differ to a marked degree from the changes incident to the usual methods of heating metals in that a small mass of the electrode in welding is subjected to a high temperature for a very short interval of time. The distinctive thermal feature of metallic are welding is then the sudden rise and fall of temperature in the metal transmitted to the plate. Under the circumstances it may be seen that the melting of the iron is delayed by the heat absorbed by the other constituents of the electrode and that this fact, together with the limited time of application of high temperature, disproves the possibility that the iron is completely vaporized in the welding process. For example, when a projectile is fired from a large gun, the initial temperature of the gas behind the projectile is believed to range between 3000 deg. and 4000 deg. C. Although this temperature greatly exceeds the melting point of the material of the projectile, there is little evidence of melting on the surface of the projectile because the projectile is not heated by the adjacent gas for a period long enough to melt its surface.

An increase of temperature in most materials is usually accompanied by an immense change in volume. While various changes in volume may take place among the constituents of the electrode during metallic arc welding, the greatest possibility for such expansion may be found in the formation of carbon monoxide. It is therefore to be expected that a globule will be formed by such expansion on the end of the electrode during welding. Typical electrode globules developed in this manner by various lengths of arc during the welding process are shown in Fig. 1. Each globule contains a cavity which may be seen clearly during welding on the ground glass of the camera described above and is also present in the cold contracted globules shown in the figure. In the smaller globules the cavities are usually open and resemble small drill holes, while in the larger globules the cavities are usually closed and are surrounded by a thin skin of metal.

An electrode globule maintained in continuous contact with the plate to prevent the formation of the glaring arc and heated by a heavy current may be seen under magnification on the ground glass to expand and blow out minute particles at high velocity from the thinnest side walls, a contraction of the globule occurring after each expulsion of particles. The particles appear to originate in the inner electrode surface of the globule. If the globule is suddenly detached and the arc interrupted at the same instant in ordinary long-arc welding, the inner electrode surface of the globule presents the appearance shown in Fig. 2. The pitted electrode surface suggests irregular fusion due to different temperatures of fusion, vaporization and chemical combination of the ingredients under the influence of rapid changes in temperature.

Owing to the complex structure of the electrode, it is not easy to determine the exact nature of the vapor content of the globule. That the vapor consists partly at least of carbon monoxide gas is suggested by the fact that such globules do not form in general when the end of the electrode is heated in a reducing (deoxidizing) atmosphere. It is also found impossible to weld with an electrode containing practically no carbon in a reducing atmosphere. In welding under water it was observed that bubbles of gas rise continuously to the surface of the water and burn, indicating the possible dissociation of the water with the absorption of oxygen by the electrode and the rejection of hydrogen to the surface of the water. After a globule had been maintained for several minutes at high temperature in contact with a plate in air, it was observed that all expulsion of particles ceased. It may be inferred from this that all of the vapor-forming constituents of the globule had been burnt out.

If the electrode while welding is suddenly swept across

* An analysis of steel electrodes usually reveals the presence of at least ten elements: iron, carbon, manganese, copper, sulphur, phosphorus, silicon, oxygen, nitrogen and hydrogen.

an adjacent flat insulated surface, small spots of metal are found on the surface at regular intervals over the surface traversed by the hot electrode. (A magnified view of one of the spots is shown in Fig. 4.) The same effect was observed by holding an incandescent electrode—just removed from ordinary welding—over the rim of a revolving iron wheel. It was determined in this way that the average frequency of projection was fifty per second. The duration of such projection was approximately one-fifth of a second, the projection terminating with the cooling of the electrode.

It would appear from the observed facts that the metal deposited during metallic arc welding is transmitted, in part at least, in the form of minute particles which are projected from the electrode globule by the internal expansion of some vapor, possibly carbon monoxide. The expelled particles pass through the arc too rapidly to become vaporized and reach the plate in a fluid state. If the expelled particles strike solid metal, they either ricochet along the surface—which explains the accumulation of iron dust in the welding room—or flatten out without fusion, the most common cause of poor welds. If the particles strike a fluid metal, they penetrate the fluid and solidify with the molten surface of the plate.

FIG. 3—DUST MAGNIFIED 20.7 DIAMETERS WHICH ACCUMULATES AROUND THE WORK DURING METALLIC ARC WELDING

It is a well-established fact that the best welding is obtained with the shortest arc and the worst welding with the longest arc. It will be noted in Fig. 1 that the size of the electrode globule also increases with the length of arc, the best welding being obtained with the smallest globule. A small globule implies greater concentration of projected particles in the direction of the opposite fluid spot. In downward welding a large globule becomes elongated by gravity, the lower part of the hollow globule becomes thickened by downward flowing metal, the side walls become stretched and thinned, and particles are projected wastefully through the side walls at right angles to the arc. The globule as a whole frequently breaks away from the electrode and drops without fusion on the plate. Electrode ends rejected by a welder and presenting the appearance shown in Fig. 1 constitute substantial evi-

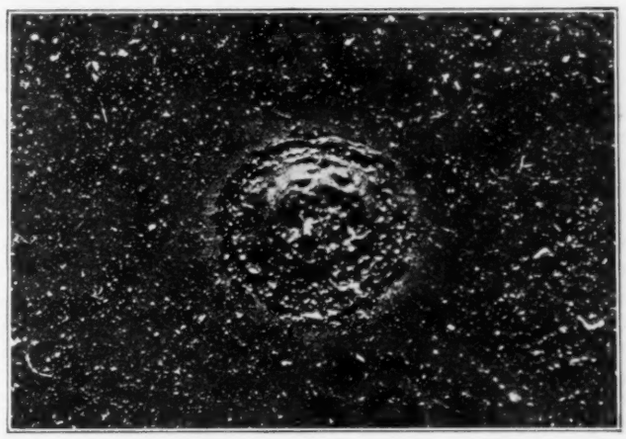


FIG. 4—A HIGH MAGNIFICATION (16.7 DIAMETERS), OF A NUCLEUS OF METAL PROJECTED ON A COLD PLATE FROM AN INCANDESCENT ELECTRODE GLOBULE

dence of ineffective long-arc welding. In upward welding a large globule tends to fall to one side or the other by gravity and prevents the efficient projection of metal.

Any material which serves to increase the melting point of the surface of an electrode must, in accordance with the stated theory, improve the conditions under which particles are projected from the electrode globule. The cup-shaped surface formed at the end of such an electrode will reduce the amount of indirect projection of particles to a minimum, and the increased stability of the arc will reduce the difficulty of manipulation of the electrode, since the length of arc may be varied over a greater range without interruption. It would appear that most of the coatings suggested for electrodes perform the function of cooling the surface of the electrode by vaporization and in some instances, owing to the rapidity of the action, remain in a fluid condition about the sides of the electrode globule. It should also be noted that since iron oxide (rust) has a higher melting point than steel, rust should not be removed from electrodes and that rusty electrodes will usually work better than bright clean ones. In many cases the outside layer of bare electrodes may be changed by drawing and heat treatment so that it has a higher melting point than the interior. The ideal electrode would have a high-melting-point shell—tungsten for example—surrounding a lower-melting-point interior containing sufficient vapor-forming constituents to eject metal constantly when heated.

The writer would suggest certain promising subjects for further study: First, a determination of the character of the vapor found in an electrode globule; second, a determination of the best surface material for electrodes, first cost and effect on the finished weld to be considered; third, the effect of welding in a reducing flame upon the character of the weld—the writer has found that such a weld is more ductile and reveals less formation of nitride; fourth, an investigation of the value of welding under water as in the case of ships, tanks, etc.; fifth, the use of materials other than steel in metallic arc welding.

The Personnel of the Industry*

Question of Labor Is of Great Importance to Central Stations, and the Organization of a Personnel Bureau Will Aid in the Selection, Training and General Welfare of Employees

BY WILLIAM C. L. EGLIN
Vice-president and Chief Engineer Philadelphia Electric Compaany

DURING the period of the war all of the industries were seriously affected in every branch of the human element connected with them. This was the natural result of the change from peace to war conditions, which involved the withdrawing of a large proportion of the man power of the nation from a producing to a defensive or fighting position. This necessitated an increase in production by our industrial sources handicapped by this shortage of labor, first, to supply the fighting forces, and second, to feed and equip them—with a reduced personnel to take care of these and their own requirements—making immediately a shortage of labor in all classes, an increase in the cost of all supplies and a very rapid increase in the rates paid to all classes of both skilled and common labor. This condition has affected not only the utilities but all industries and has been carefully considered by various branches of the government and by organizations which are making special studies regarding proper rates of compensation, hours of labor, welfare conditions, etc.

Previous to these studies, much had been written regarding scientific management, shop systems and the so-called "efficiency methods." There have also been a number of bills before the legislatures regarding the fixing of the hours of labor, minimum compensation and health insurance, the right of employees to engage in collective bargaining, the development of the labor supply, the occupations for which women are suited, the age limit for the employment of children, compensation in cases of accident, and insurance for permanent disability.

Peace Conditions

With the great changes which took place during the war and since the close of the war further complications have arisen, and the broad question of labor is probably the most important subject before the nation to-day.

The ideal organization is assumed as one in which to the individual are given the task for which he is best suited, the opportunity to advance and enlarge his usefulness as his ability and standing increase, a proper allowance of time for recreation, a compensation which will be sufficient to cover his ordinary living and recreation expenses, the opportunity to increase his compensation, either by producing a better class of work or through greater output, so that he may set aside a fund sufficient to take care of sickness and provide for himself during the later years of his life, and some form of discipline which will penalize the man who is either careless or negligent in his tasks and will keep him to his task and prevent him from injuring others.

Much has been written about the so-called eight-hour day. Careful analysis regarding the eight-hour day would seem to show that it is for the purpose really of fixing the rates of mechanics usually engaged on construction work. Men who, owing to the nature of the task, may require to work longer than eight hours must be paid an extra compensation, generally time and a half time or double time, for Saturday afternoons, Sundays and holidays. There has been further agitation for even a six-hour day. This is clearly an effort to raise the rate of wages and an effort to limit production with the idea of preventing non-employment. I am strongly of the opinion that any effort to limit, through constitutional or legislative action, the hours of labor is wrong, as it interferes with the rights of the individual. The rate of working and the endurance of men or women vary greatly, so that the slower person with greater endurance should have the right to employ his natural faculties as best suits him. In a task that requires twenty-four hours, and for that class of work only I believe the eight-hour schedule is correct.

It would seem logical that some form of profit-sharing should be the basis of compensation instead of the usual basis of the current rate that competitors are paying or the rate fixed by trade unions. A base rate should be fixed

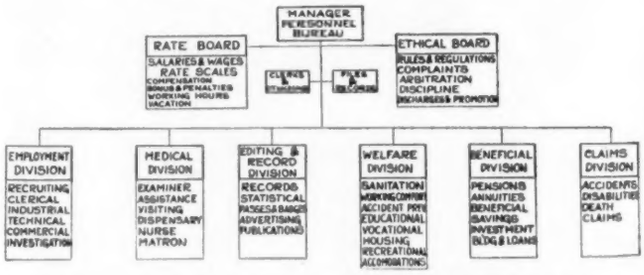


FIG. 1—CHART OF PERSONNEL ORGANIZATION

on the living conditions in any particular section of the country, and added compensation would depend upon the ability of the individual. The management should lay out a careful schedule of rates for the position in the group performing the task, and at the same time determine a cost sheet on the basis of the current price of materials and the basic cost of labor. Any reductions which may occur below this point should be divided in proper proportion between the three parties at interest, viz., the employees, the owners and the public. Such a division would vary with different localities and under different conditions, but can be worked out for each locality. This would necessitate practically a specification of performance of each individual, so that he may understand, in a large organization, exactly the task he would be expected to perform, what his compensation would be under normal conditions and the increased compensation he would earn according to his own ability.

Specifications should also be prepared for the performance of groups, so that the value and benefits to be gained from team work may also be properly provided for. The task to be performed by the organization can be performed most effectively only if every individual in the entire

* An abstract of a paper presented before the Association of Edison Illuminating Companies, New London, Conn., Sept. 15 to 18, 1919.

group is in a position to function properly and co-ordinate his efforts with those of all others in the organization, and more particularly with those of his specific group.

In the purchase of materials collective bargaining has been successfully adopted in many cases, and in the fixing of rates for men engaged in the same task there can be no logical objection to it, should the entire group be in favor of this method of fixing their compensation. Collective bargaining, however, cannot equitably meet the situation unless some differential is adopted, as no individuals perform the same task equally; and although it may have been successful in increasing the compensation for a group of individuals, it is an average method and not an accurate method.

Trade Unions

The trade union was the outcome of abuses in the treatment and particularly in the compensation given the several classes of workers, necessitating an organization strong enough to combat those who treated them unjustly and to provide the means for this purpose. As trade unions were organized principally for combative purposes, their organizations were built up on fighting lines, so that they

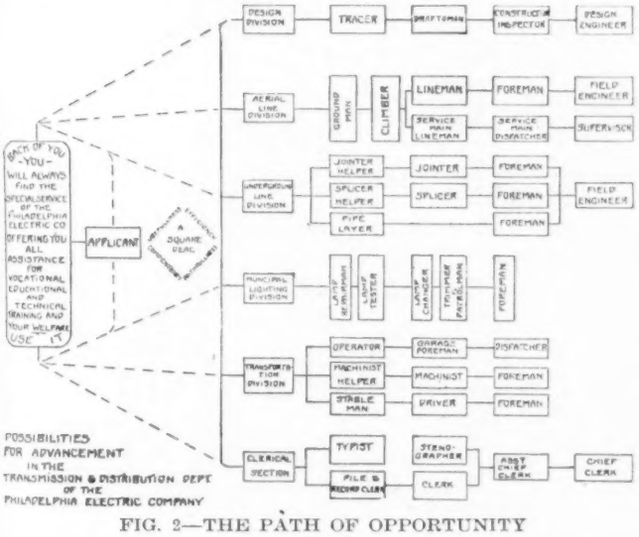


FIG. 2—THE PATH OF OPPORTUNITY

could do the greatest harm to their opponents with the least injury to themselves.

Although much good has been accomplished by the trade unions in improving the general conditions of the worker, and although they have many strong friends and adherents, their principal weakness is their combative form of organization and their lack of responsibility to the established laws of the community. The commonly employed weapon of the "strike" has produced great losses in money, lives and personal sacrifices. The strike is a double-edged sword—it injures both parties. It should be completely abolished, as it is not scientifically sound because it is not truly helpful to any one. It injures the employee and the employer and often many other innocent citizens who may be in the vicinity.

Trade unions should organize under the laws of the state in which they are formed, and should place themselves in a position of advocating increased output, increased compensation depending upon the individual's ability, a minimum wage scale that will fairly meet living conditions, opportunities for the individual to produce as much as possible, with the greatest liberty as to hours of labor, and varying compensation depending upon the individual's ability to perform his task.

Trade unions must also be prepared to discipline their members who fail to carry out the spirit or intent of an agreement or contract. They should lend their efforts to improving the individual ability of their members, for with increased skill and efficiency come increased compensation and additional hours for leisure and recreation.

Employment of Women and Minors

In a number of industries the positions which have been opened to women in the last few years have greatly increased, and it is evident that there are very few occupations in which women, if properly selected for the position, cannot compete successfully with men. The part that the women are taking in helping to perform the tasks of the community should be of assistance in improving the general conditions. Women have been kept out of many enterprises largely through prejudice and the foolish idea that it lowered a woman's standing in the estimation of the rest of the world to go into business or to become a paid worker. There is no logical argument that can be brought forward to support this attitude, and along with the general adoption of woman suffrage, women must be given equal rights and equal compensation for tasks similar to those performed by men.

Much has been said, and the opinion has been held by several important authorities, that there has always been a shortage of labor in this country. The principal means to supply this shortage has been by immigration. During the last few years this has been seriously interfered with, and it has been stated that immigration will be restricted for several years to come. Should this be the case, then we must look to other sources at home to make up this labor shortage.

In 1919 there are approximately only 14,600,000 women engaged in gainful occupations, as against 37,000,000 men. From a study of the proportions of male and female workers by age divisions it is seen that those of women closely follow those of men. The utilization of this source should be of material advantage in overcoming the shortage due to restrictions on emigration. It would therefore seem logical that the electric utilities should employ women in as many positions as possible.

The laws which provide for the protection of minors are usually too severe and are intended primarily to protect the minor from being imposed upon by working him long hours, which would interfere with his education and his physical development. These laws should be modified so as to permit minors of an age beginning, say, at twelve years to perform one or two hours of work daily at hours that would not interfere with their education.

Personal Upbuilding

To build up the ideal organization from this we must first select the individual for the position which he is to occupy. We must also have a schedule of the various steps that he will probably take during the natural course of his career in the industry. It must be kept in mind that when the individual is employed he should be employed primarily with the thought that he will make service in the electric utility his life work, and the various probable steps and advancements that he can make in the organization should be charted for him.

There must also be provided the necessary physical and mental training, commonly called "vocational training." At the time his mind is in the most receptive condition the

advantages of saving should be pointed out to him and some means provided so that his savings may be properly guarded. If the organization is large enough, means should also be provided in order that he may have suitable outdoor recreation with his fellows; also that he may be taken care of in sickness or in any disability due to accident. It should be impressed upon him that he is part of an organization, and that if he fails properly to perform his task, it will affect others in the organization, and that he will he disciplined for such failures. Means must further be provided so that should an error have been made in selecting him for his position, he will have an opportunity to be placed in another position for which his natural abilities and inclination prove to be more suited.

During this period the individual should develop a pride and desire to add to the standing, good will and reputation of the organization, and should be grounded in the value of team work. His individual responsibilities and the responsibilities which he owes to others must be frequently pointed out during this development or formative period. This means that there must be abundant opportunities made for all groups in the organization to "get together" and for the entire organization to "get together," so that all of the employees may know each other and have the opportunity to exchange experiences, difficulties or troubles. Each member of the organization must feel at all times that he can go to the men higher up, or even to the man at the top, if he needs advice or help.

Any employee who quits, leaving a task unfinished, or who induces others to quit, is a slacker, a coward and a contemptible person of the lowest order, because he not only is injuring himself but is also injuring his friends. His previous training has shown him that if he meets with any difficulties, he has the right to take them up with those who can help him, or if he feels he can do better elsewhere, the road should always be opened for him to resign, with the best wishes of his fellow-workers.

Each man engaged in the enterprise must first be taught to think of his part in the work, and he must be shown the value of performing his task to the best of his ability; also he must be assured that he will be compensated properly and that his compensation will increase as he improves in the performance of the task.

It is naturally essential that the directing heads of the organization should know intimately the requirements of the individuals of their divisions, and that the sub-heads should know intimately the requirements of those in their subdivisions.

Each individual, being fully informed of what is expected of him and having a knowledge of the more important parts of the task, has the opportunity to fit himself for higher and more responsible positions.

The task requiring a large number of individuals can most effectively be performed by the combined training of the mind and body, to enable the individual to give his best faculties to the performance of his own task. Many of the difficulties of the past have been caused by having the "boss" do the thinking for his men.

Personnel Bureau

The organization of a personal bureau to take care of the selection, training and general welfare of the personnel of the organization is commendable. This bureau should have for its purpose the maintenance of the personnel. Some of its duties would be as follows:

1. To obtain a large number of applications for positions in the organization. In the past little effort has been made to attract men, except in some special instances, such as technical men. The first duty of the bureau should be to advertise that the company will be glad to receive applications for all positions. The effort should be made so that a person applying at any one of the company's properties will be politely treated and will be handed a card stating that the bureau will be glad to interview him and giving the particulars as to how the heads of the bureau can be reached. The bureau will take the record of the applicant and will communicate this information to the division heads who may require assistants.

2. The bureau will prepare, in conjunction with the heads of the various groups in the organization, specifications covering the requirements of the individual for each position.

3. The bureau will prepare, in conjunction with the heads of the various groups in the organization, a task card which will clearly outline the duties for each position.

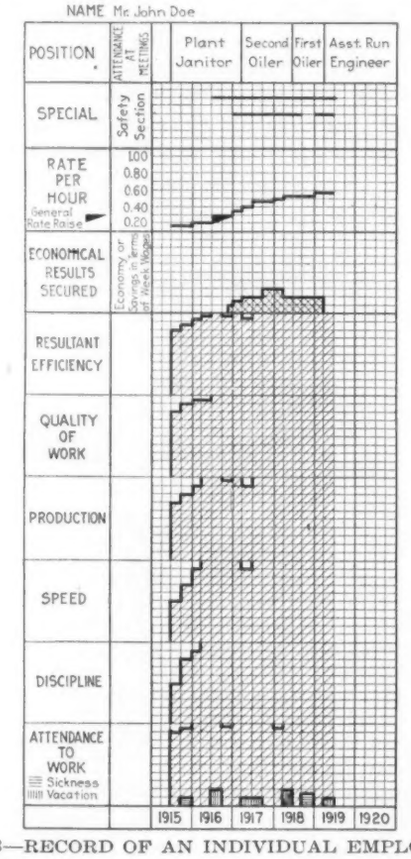


FIG. 3—RECORD OF AN INDIVIDUAL EMPLOYEE

4. The bureau will prepare a chart or form that will give the probable progress of the individual and what his various stages of advancement should be. This is particularly important in conjunction with the younger men in the organization.

5. The bureau will prepare a service record and history card of the individual, upon which his record during his entire service with the organization is to be entered.

6. The bureau will study, in conjunction with the division heads, the proper compensation and the hours of labor of each position. This study should start with the individuals in the lowest positions, should be applied to all individuals who are responsible for the completed task, should be comprehensive, and should place a value on

team work in the divisions of the organization as well as in the entire organization, so that team work between the divisions in the organization may be fostered.

The bureau will also study and be prepared to recommend to the rate board profit-sharing plans and the bonuses that may be earned by the individual, the group and the division and by the entire organization. In other words, the savings may be divided into four parts. This rate board should be large enough to represent all of the activities of the organization.

7. The discharging of all employees should be viseed by this bureau. Any person will have the right to a hearing by the bureau, which will investigate the case, and should its findings be such, it will endeavor to retain the person, or he may be placed in another department of the organization.

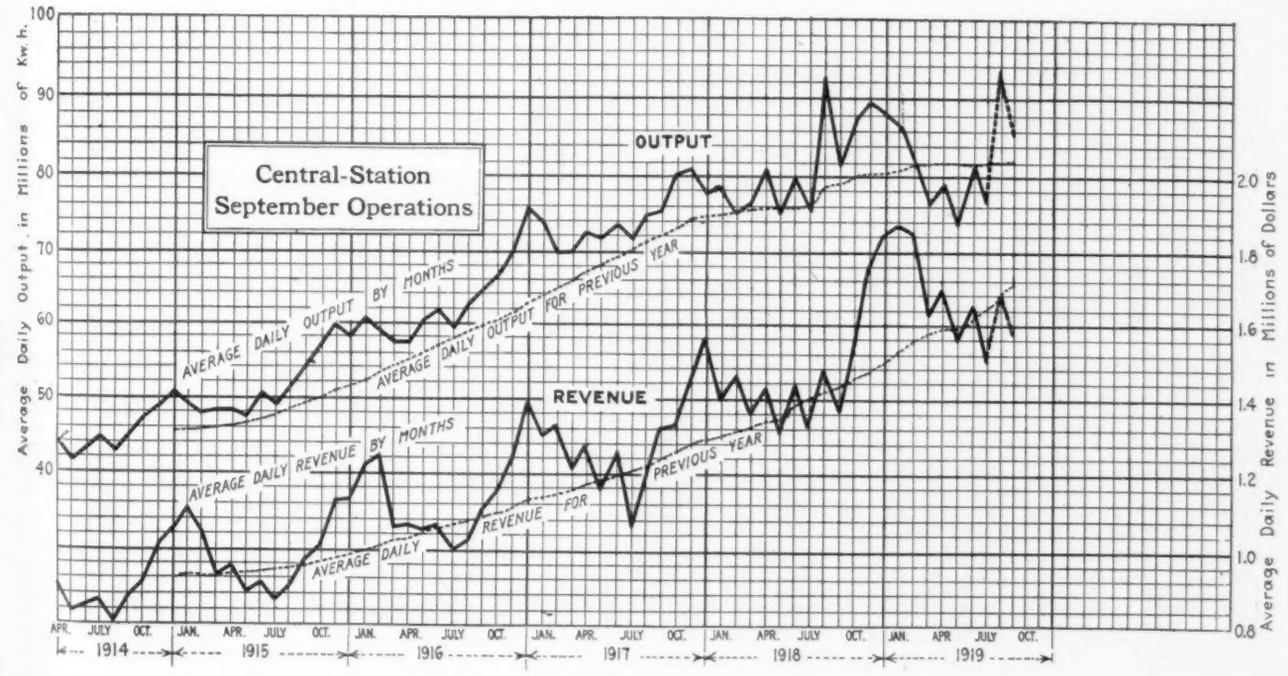
8. This bureau should be in direct contact with all educational work and vocational training, the number of hours of labor, sick, accident and insurance funds, and recreation and general welfare conditions.

The personnel bureau should be enlarged as the organization grows so as to include specialists in each line of endeavor. Its slogan must be, "A square deal for every one," and its object to be helpful to all in the organization.

The important features of this plan are the encouragement of applicants for positions in the organization, the scheduling or charting of the applicant's opportunities for advancement through his own working life instead of more or less temporary employment, the establishment of a wage scale based on the value of the position and of a bonus system which starts from the bottom, in which every individual is entitled to share, the recognition of the necessity for team work, the co-ordination of all welfare work, and the recognition of this work as part of the work of the organization. The personnel bureau should have a standing and authority equal to any of the principal divisions in the organization.

The character and reliability of the electric utility's service are so vital to the community it serves that it is essential that the highest class of personnel should be selected. Should an employee for any reason prove unsuited for the task assigned to him, he will, if possible, be given one which will be better suited to his natural faculties. If he errs, he will be disciplined, but not necessarily discharged without a hearing. In this way the great loss due to labor turnover will be very much reduced.

Substantial Increase in Revenue



GENERAL electrical prosperity is reflected in the returns from central stations received by the ELECTRICAL WORLD for the month of September. The percentage of increase in output over September of last year is 2.8, the highest monthly increase since April. Central-station revenues showed a substantial increase, the percentage of increase over September of 1918 being the highest since March.

With but few exceptions the textile interests of New England called for capacity power in September. In the Atlantic States the steel and coal interests continued to increase their power requirements. The rate of steel ingot production was estimated at between 80 and 85 per cent of capacity during the first part of September, against 75 per cent in July and 54 per cent in May, and this maximum call for power during the first part of the month by the steel industry is reflected in the returns despite the general decreased call for power in this country during the latter part of September.

The returns from the Central States, however, are the lowest since May, probably owing in no small measure to the steel strike which started Sept. 21 and which virtually

stopped steel production here. The output in this region so far as the incomplete returns show was about 180,000,000 kw. less than in August. The Pacific and Mountain States still showed a slight decrease in output over the similar period in 1919, but considerable recovery has been made from the slump noticeable in August. While the copper regions called for slightly less power than in August, this decrease was not sufficient to offset the measurably improved conditions in California and certain parts of Washington and Oregon.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Industry Represented	Revenue from the Sale of Energy			Kw.-Hr. Output		
		1918	1917	Per Cent Increase	1918	1917	Per Cent Increase
Oct.	56	$26,254,000	$23,228,000	13.0	1,517,866,000	1,392,359,000	9.0
Nov.	57	29,883,000	25,894,000	15.4	1,528,836,000	1,383,747,000	10.5
Dec.	56	32,058,000	27,128,000	18.1	1,539,161,000	1,369,542,000	12.3
		1919	1918		1919	1918	
Jan.	57	33,294,000	27,589,000	20.6	1,522,660,000	1,357,460,000	12.1
Feb.	54	28,130,000	23,162,000	21.4	1,249,806,000	1,157,275,000	7.9
Mar.	57	28,569,000	24,420,000	16.8	1,357,981,000	1,341,374,000	1.2
Apr.	54	27,629,000	23,814,000	15.9	1,278,273,000	1,240,842,000	2.9
May	55	26,389,000	23,023,000	14.6	1,255,598,000	1,267,878,000	—1.0
June	57	28,129,000	24,676,000	13.8	1,397,213,000	1,367,018,000	2.2
July	55	25,716,000	22,523,000	12.5	1,306,883,000	1,281,120,000	2.1
Aug.	55	28,562,000	25,177,000	13.9	1,592,913,000	1,584,476,000	0.1
Sept.	51	23,812,000	20,834,000	16.6	1,290,705,000	1,258,741,000	2.8

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	Percentage of Industry Represented	New England States			Percentage of Industry Represented	Atlantic States			Percentage of Industry Represented	Central States			Percentage of Industry Represented	Pacific and Mountain States		
			1918	1917	Per Cent Increase		1918	1917	Per Cent Increase		1918	1917	Per Cent Increase		1918	1917	Per Cent Increase
REVENUE	Oct.	63	$3,360,000	$3,036,000	10.6	51	$8,822,000	$7,924,000	11.3	50	$9,218,000	$7,848,000	17.4	81	$4,854,000	$4,420,000	9.8
	Nov.	64	3,695,000	3,238,000	14.1	55	11,877,000	10,400,000	14.2	50	9,277,000	7,704,000	20.4	81	5,034,000	4,552,000	10.6
	Dec.	64	4,097,000	3,449,000	18.7	55	11,927,000	10,199,000	16.9	50	10,781 000	8,836,000	22.0	79	5,253,000	4,644,000	13.1
			1919	1918			1919	1918			1919	1918			1919	1918	
	Jan.	63	4,253,000	3,443,000	23.5	60	13,444,000	11,168,000	20.3	47	10,410,000	8,484,000	22.7	77	5,187,000	4,494,000	15.4
	Feb.	63	3,895,000	3,048,000	27.7	53	10,894,000	8,943,000	21.8	45	9,305,000	7,484,000	24.3	73	4,036,000	3,618,000	11.5
	March	64	3,608,000	3,044,000	18.4	58	11,731,000	10,244,000	14.5	47	9,012,000	7,447,000	21.0	81	4,218,000	3,685,000	14.4
	April	64	3,473,000	2,964,000	17.2	51	11,408,000	10,114,000	12.7	47	8,420,000	6,981,000	20.5	76	4,328,000	3,755,000	15.3
	May	62	3,194,000	2,800,000	14.0	51	9,430,000	8,571,000	10.0	47	8,297,000	6,888,000	20.4	77	5,468,000	4,764,000	14.7
	June	64	3,321,000	2,925,000	13.3	55	10,535,000	9,478,000	11.2	50	8,757,000	7,504,000	16.7	78	5,516,000	4,767,000	15.8
	July	61	3,329,000	2,949,000	13.0	50	9,319,000	8,375,000	11.8	50	8,854,000	7,442,000	18.0	79	4,214,000	3,756,000	12.3
	Aug.	60	3,386,000	2,985,000	13.6	53	10,565,000	9,410,000	12.0	47	9,341,000	7,917,000	18.1	78	5,270,000	4,865,000	8.0
	Sept	60	3,556,000	2,144,000	13.1	53	8,920,000	7,710,000	16.0	35	6,441,000	5,571,000	15.8	74	4,896,000	4,409,000	10.1
			1918	1917			1918	1917			1918	1917			1918	1917	
KW.-HR. OUTPUT	Oct.	63	139,784000	128,970,000	8.3	51	481,222,000	440,268,000	9.3	50	479,990,000	442,054,000	8.5	81	416,870,000	381,067,000	9.4
	Nov.	64	138,559,000	123,033,000	12.6	55	542,799,000	495,812,000	9.4	50	444,012,000	396,665,000	11.9	81	403,566,000	368,237,000	9.6
	Dec.	64	145,543,000	129,838,000	12.1	55	405,253,000	421,973,000	12.6	50	489,864,000	443,544,000	10.4	79	428,906,000	374,906,000	14.6
			1919	1918			1919	1918			1919	1918			1919	1918	
	Jan.	63	143,254,000	124,632,000	14.9	60	525,322,000	458,545,000	14.5	47	463,394,000	403,127,000	14.9	77	390,690,000	371,156,000	57.2
	Feb.	63	128,660,000	109,993,000	17.0	53	406,702,000	374,958,000	8.4	45	426,965,000	378,992,000	12.6	73	287,479,000	293,492,000	-2.0
	March	64	125,510,000	124,707,000	0.7	58	459,166,000	461,096,000	-0.4	47	442,591,000	423,802,000	4.4	81	330,714,000	331,769,000	-3.0
	April	64	123,211,000	118,322,000	4.1	51	382,282,000	369,701,000	3.4	47	373,116,000	345,213,000	8.1	76	328,925,000	333,405,000	-1.0
	May	62	120,949,000	122,531,000	-1.3	51	362,207,000	383,860,000	-5.6	47	389,805,000	375,944,000	3.6	77	382,637,000	385,543,000	-0.7
	June	64	127,355,000	119,946,000	6.3	55	406,102,000	417,441,000	-2.7	50	417,942,000	386,422,000	8.4	78	445,814,000	443,209,000	0.6
	July	61	139,133,000	129,639,000	7.4	50	373,105,000	378,053,000	-1.5	50	428,370,000	408,165,000	5.0	79	366,275,000	365,263,000	0.3
	Aug	60	138,885,000	133,915,000	4.1	53	552,884,000	563,478,000	-2.0	47	461,769,000	427,449,000	8.3	78	439,365,000	459,638,000	-4.1
	Sept	60	136,555,000	130,509,000	4.5	53	490,640,000	488,357,000	0.6	35	279,780,000	253,487,000	4.2	74	383,729,000	386,188,000	-0.9

THE investor is entitled to a reasonable return on the value of his property devoted to the service of the public. The interest of the general public demands that such return shall be sufficient to attract the new capital required for extensions and betterment under normal conditions.—*Missouri Public Service Commission.*

COMMERCIAL MEN IN THE CENTRAL-STATION FUTURE

President Ballard of the National Electric Light Association Points Out the Need of Careful Marketing of Power

The large place of the commercial man in the future of the central station was discussed by President R. H. Ballard of the National Electric Light Association in his talk at the annual convention of the New England Section.

Mr. Ballard spoke of the reduction in purchasing power of the dollar and of the fact that central-station rates have not been advanced in proportion to the lessened value of revenues. "Measured in bushels of wheat," said Mr. Ballard, "the rates of central-station companies have in fact been reduced 50 per cent. Some have succeeded in getting through their regulating commissions what are called increases in rates. Maybe a rate per kilowatt-hour has been raised from 10 cents to 12 cents, we will say. But how about that as compared with the bushel of wheat? It is only a partial restoration of rates, is it not?"

Continuing, Mr. Ballard mentioned the position of the regulating commissions. He recalled that in the past, when rates have been reduced, business has been stimulated and companies have lived, however, for one particular reason, and that is the engineers, speaking nationally, have saved the companies, saved their business by increasing the efficiency and developing economies in generation and distribution. Arguing that the limit of possibilities has nearly been reached in efficiency of existing apparatus, and that the work of the engineers is now concentrated on interconnection, Mr. Ballard said that when the systems are tied together the commercial man must take hold.

The speaker declared that the future of the industry depends upon the commercial men's vision. When systems are interconnected and the maximum capacity of systems is available further investment in generating stations will be conserved and the return from rates increased.

TROUBLES FROM VIBRATION IN TURBO-ALTERNATORS

Effectiveness of Dynamic Balances Depends Greatly on Method of Mounting Machine—Causes of Vibration, How Identified and Remedied

BY E. V. AMY

TROUBLES caused by vibration of rotating machinery are considerably on the increase in connection both with ships and with power stations on land. The importance of the subject of vibration set up in machines cannot be overestimated, especially in these days of high rotational speeds where the whole question of balancing has assumed redoubled importance. In the reciprocating engine with its low speed any lost motion or misalignment made itself known as a knock or pound, while now in the case of the turbine with its high speed and delicate balancing the slightest knock or pound may develop into very serious vibration and cause considerable damage.

For the proper balancing of the rotors of steam turbines and alternators two balances are required to insure a steady running condition—the static balance and the dynamic balance. The static balance is obtained by revolving the rotor by hand on a pair of knife edges or balancing stools and allowing it to come to rest; the point at the bottom will be the heavy part. Temporary plates are fixed to the wheel opposite this part, and the rotor is again revolved and weights are added until it will remain or come to rest in any position. In the case of very large rotors all the elements which make up a complete rotor such as the drum, wheels and spindles are each carefully balanced before assembling and then the whole rotor statically balanced in the manner described.

Fig. 1 shows diagrammatically the general method of statically balancing a large high-pressure rotor having two wheels of the same diameter, one forward and one aft. In such cases it is usually best to put one-half the total

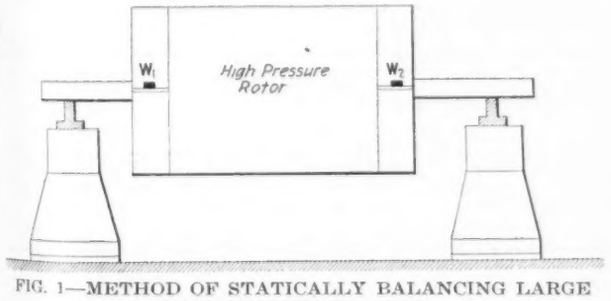


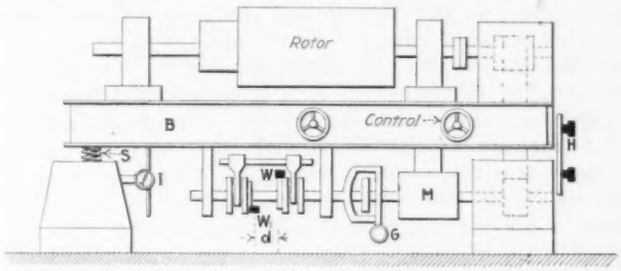
FIG. 1—METHOD OF STATICALLY BALANCING LARGE HIGH-PRESSURE ROTOR

balance weight on each wheel as shown. An important point is to put all weights in line if possible, and to have them duplicate as regards bolt holes or other relative markings.

The turbine is balanced dynamically by being revolved at about half speed by steam acting under working conditions, and tested for vibration by fixed pointers or by pencils held lightly against the framework of the machine. At the present time no system of calculation is employed in either of the above balances, the results generally obtained being entirely dependent upon the experience, skill and patience of the workman.

The dynamic balancing of both the turbine and alternator rotors is first made with as much care as possible by the manufacturer on a special test floor. After the machine is installed in the power house where it is to be used and before being allowed to go into commercial operation it is tested for balance under working conditions to remedy any out-of-balance that might occur during shipment or in the course of erection.

The details of the apparatus employed by the various manufacturers for dynamically balancing their machines



B - Vibrating Bed Plate
H - Hinge
I - Vibration Indicator
G - Gear of Planetary Drive
M - Driving Motor
S - Supporting Spring

W, W1 - Compensating Weights
d - Distance between Weights
Max. Capacity of Machine about 14,000 lb.

FIG. 2—MODIFICATION OF BALANCING METHOD SHOWN IN FIG. 1

vary in design, but in general the method is to rotate the body at operating speed by some external power with the shaft and bearings spring held so as to allow a slight oscillation of the shaft in one plane to be produced by any out-of-balance condition of the body. The shaft is chalked at each end, and by gradually advancing a fine metal stylus until it lightly touches the shaft at the high spots of the oscillation a mark will thus be made in the chalk, indicating the relative place where the weight should be changed. The weight is altered and the test repeated until balance is obtained for that end of the shaft, so that the stylus will make a light continuous mark around the shaft. The other end is then balanced in the same manner, thus completing the dynamic balance of rotor and shaft as a whole with respect to the journals in which the shaft is held.

Within the last few years a modification of the above method has been developed and the operation carried out by a machine of special construction shown diagrammatically in Fig. 2. It gives accurate and very rapid results for small-sized rotors. The machine is so designed and calibrated as to indicate the amount and the angular position of the unbalanced couple required to produce a dynamic balance for the rotor under test and for the speed at which the test is made. It consists, essentially, of a horizontal bed hinged at one end and free to vibrate in one plane at the other end. The latter end is mounted on a steel spring having the same natural period of oscillation as the speed at which the rotor is to be balanced. The rotor is coupled to a driving mechanism operated by an electric motor. As the free end of the bed vibrates it is made to move a pointer or vibration indicator. Compensating weights are attached to a special frame hung underneath the bed plate and connected to the driving motor through a planetary drive. The relative position of the weights can be altered by a hand screw during test, and the distance which they are moved apart determines the centrifugal couple which is necessary to overcome the unbalanced force set up by the rotor at that speed. This is read directly in inch pounds and can there-

fore be applied to the rotor in the form of a certain weight at a distance depending on the amount of the unbalanced force as indicated by the scale reading. The proper position where the weights are to be added to the rotor is also determined by the relative position of the compensating weights on the special frame.

Difficulty of Obtaining Absolute Balance

Few large rotors are actually in a state of perfect balance owing to the difficulty in obtaining an absolutely accurate dynamic balance. Furthermore, a physically perfect balance for all speeds is not attainable. The greater the speed at which any rotor is to be operated the more careful and accurate must be the dynamic balancing. The intensity of the vibrational force due to out-of-balance of a rotor will in magnitude be proportional to the square of the speed, and the number of times this force is applied per minute will vary directly with the speed of the machine. Therefore if we consider only the fatigue stress, the harmful effect of a given amount of lack of balance will increase as the third power of the speed of rotation.

A dynamic balance considered perfectly good for a certain environment may be a bad "out-of-balance" in other surroundings. A large high-power machine that runs quite smoothly on a massive bed of concrete may set up conditions which resonate with any little "out-of-balance" that the machine may have. it is promptly blamed for the trouble and often condemned; whereas in many cases it could have been made to run perfectly well by using a little more forethought in slightly modifying the foundation.

In all bodies revolving at high speeds about fixed axes there is a period at which vibration will become excessive. This is called the critical point of speed and is believed to be caused by a change in the axis of rotation due to deflection or bending of the shaft, which causes the rotor to revolve about a new axis, termed the axis of deflection, and which alters the center of gravity of the rotor and causes vibration. This may not occur at the highest speed, as sometimes the vibration decreases as the speed is increased.

Vibration in machines like steam turbines may be due to causes internal as well as external, or both, the result being cumulative or otherwise. The most serious and dangerous cause of vibration in turbines, although not frequently encountered, is that due to revolving parts improperly coming in contact with the stationary parts. This especially applies to the buckets. Such trouble will lead to the greatest damage if not discovered and properly dealt with at once. A vital maxim in turbine practice is to avoid any internal rubbing.

VIBRATION TROUBLES IN TURBO-ALTERNATORS. Classified for handy reference by E. V. Amy, E. E.

Cause	Probable Reason	How Identified	Precautions
Unbalance	a. Sprung shaft. b. Improperly placed balance weights c. Displacement of balance weights. d. Sediment in blades or buckets. e. Corroded blades. f. Unequal heating of rotor parts. g. Unbalanced forces due to heavy distortional stresses. h. Shifting of conductors on generator. i. Unequal generator air gaps.	Uniform vibration throughout machine; same frequency as speed. becomes slightly less as load is applied; intensity of the vibration depends on amount of unbalance.	As soon as vibration becomes abnormal shut down and investigate. Remove cause; rebalance, if necessary.
Poor Alignment	a. Eccentric coupling. b. Unequal settling of foundation. c. Steam-piping strains due to expansion or weight.	Vibration of variable periodicity; slight at no load, becoming worse as lead is applied.	Check up and correct.
Bad Foundation	a. Improper grouting. b. Non-rigid fastening of bed plate. c. Non-homogeneous foundation resulting in unequal settling.	Sympathetic vibration in surrounding structure; felt all over machine; constant for all loads.	Make foundation solid; grout with lead if necessary.
Loose Parts	a. Too much bearing clearance. b. Ball joint of bearing loose. c. Loose construction in built-up rotors. d. Loose conductors on generator. e. Loose bolts or coupling.	Vibration of local nature; greatest at loose bearing; rattle or noise when starting or slowing down.	Carefully examine bearings and fastenings.
Internal Rubbing	a. Revolving buckets coming in contact with stationary buckets. b. Insufficient casing clearance. c. Deflection of a diaphragm in any one stage. d. Thrust-bearing troubles.	Abnormal vibration, somewhat localized; noise varying with the speed of machine.	Lose no time in making repairs or adjustments; may result in serious damage.
Steam Troubles	a. Water coming over with the steam. b. Sediment in the steam. c. Faulty valve gear causing irregular steam admission. d. Accidental closing of emergency steam valve, shifting generator's load to other machines.	Unusual noise near the intake; failure of steam strainer.	Make necessary repairs; test steam for sediment, acid or salt.
Packing Troubles	a. Improper adjustment of labyrinth packing. b. Packing rings too small for shaft.	Excessive lost motion in thrust bearings.	Replace old packing.
Oil Troubles	a. Breaking down of oil film due to insufficient supply. b. Oil supply cut off or too slow. c. Poor oil (frothing, gumming, emulsifying).	Heating of bearing; noisy operation; may cause damage to blading due to letting down the spindle.	Improve oil system; keep clean and well filtered.

unendurable or dangerous vibration and noise when mounted on I-beams or on a steel structure. Because commercial requirements call for standard types of machines, made in quantities to meet demands of a general market, the refinement of balance depends upon the average place and conditions of use. However, should one of these machines happen to be installed under adverse

One of the greatest troubles experienced in maintaining the proper balance of turbo-alternators is due to the shifting of the conductors. The slightest shifting of these conductors on the rotor of a large generator is likely to throw the rotor considerably out of balance. This often happens after the generator has been in operation for some time. As the insulation dries it gets compressed by

centrifugal force on the conductors, and thus they become loosened. Once the conductors become at all loose they may shift with load changes, causing deterioration of the insulation and failure under normal potential.

Another result of excessive vibration sometimes encountered in large turbo-alternators is that the emergency steam valve accidentally closes, shifting the generator's load to other machines. This may prove a serious matter where the load is 30,000 kva. or more.

Too much bearing clearance in a machine will cause vibration. Such vibration is more or less of a local nature. While it may be felt throughout the entire machine, it is usually more intense at the bearing or bearings that are loose, and is also more noticeable when the machine is running with a light load or, in the case of alternators, when the field current is off, becoming less as the field magnetism grows stronger or the load becomes greater, holding the rotor in a more fixed position. In some cases this vibration can be reduced by feeding more oil to the bearings.

The problem of proper lubrication is a very important one in steam-turbine work. If the oil film under a bearing should break down owing to a poor supply, low pressure or other failure of the lubrication system, the bearing will become heated and the spindle be let down, with the possibility of causing serious damage to the blading. Unequal wear on the bearings or shaft may in turn throw the machine out of alignment.

In general it might be said that there are many degrees of vibration in steam turbines and turbo-alternators, causing as many effects, some obvious and others not so apparent. In most cases, however, vibration sounds its own warning, and therefore under no circumstances should it be allowed to continue unnoticed; on the contrary, it should be eliminated as much as possible since it shortens the life of materials, wastes energy in the form of heat, noise and needless motion and also increases the difficulty and cost of operation.

The Most Important Considerations

In sizing up vibration troubles in steam turbines and in making a rapid investigation as to the cause of the trouble a great number of questions may come up for consideration, but first importance should be given to the following:

1. Is there any unusual noise or heating?
2. At which bearing is the vibration greatest or is it universal?
3. What effect has load variation?
4. What effect has the speed on the vibration?
5. What type of vibration is it—high or low frequency, steady or variable?

Rather than attempt to list the great variety of questions that might be asked, the outline shown on the preceding page has been arranged. Although not complete in itself, the table should prove of some value to turbine operators or assistants in general as a guide for quick reference.

The operator, in attendance on the machine must be always on the alert and very familiar with all normal running conditions as to sound and vibration, so that he can promptly detect anything unusual in the operation of any machine under his supervision and quickly diagnose the trouble, if any, and report it or apply the proper remedy at once before it becomes of such a nature as to cause damage to or wreck the machine.

SOME INFORMATION AS TO ELECTRIFIED ZINC SPELTERS

Sixty-Ton Outfit Uses 33,450 Kw.-hr. Monthly at 118 Kw. Demand and Effects Saving of Large Sum Annually

BY C. C. LOVEJOY
Commercial Manager of Fort Smith (Ark.) Light & Traction Company

Two plants that are interesting because they are said to be the only zinc smelters in the United States operated completely by electricity are located at Fort Smith, Ark.

These two plants, which manufacture zinc spelter, belong to the Fort Smith Spelter Company and the Athletic Mining & Smelting Company. The former started business about eight years ago and its plant was designed for steam operation. The latter started business about two and one-half years ago and installed electricity for power purposes at that time to the extent of approximately 300 hp. Only recently the Fort Smith Spelter Company installed fifteen motors, the total connected load being 275.5 hp. This installation was handled by the Fort Smith Light & Traction Company, which supplies the energy. Twenty-three steam engines, three boilers and much other miscelleaneous steam apparatus were abandoned in this change-over. Gas had been used for fuel, the requirements being 350,000 cu. ft. per month for power purposes. The maintenance and operating cost alone on the steam equipment had exceeded $12,000 per year, not including depreciation, interest and fixed overhead. The present installation of this company includes the apparatus listed in the table:

EQUIPMENT OF ZINC SPELTER

	Equipment	Capacity in Tons	Motor Hp.
Kilns	Three rakes	60	25
	Screw Conveyors	....	15
Dryer	Crusher	....	....
	Conveyor	60	25
	Elevator	....	....
Mixing	Elevator	....	....
	Mixer	120	10
Coal Crusher	Crusher	....	....
	Elevator	60	....
	Pulverizing Rolls	....	40
Carbonate Crusher	Breaker	....	....
	Elevator	20	25
	Rolls	....	....
Pottery	Pug Mill	....	....
	Blower	....	....
	Breaker	....	....
	Rolls	....	....
	Elevator	....	....
	Screens	....	....
	Retort Machine	....	....
	Connie Machine	....	5
Furnaces	Four 24-in. Bailey Fans (10 hp. each)	....	40
Machine shop	Machine Tools	....	7.5
	Blower	....	....
Total		....	275.5
Monthly average, kw.-hr		33,450	
Monthly average, kw. demand		118	

The installation has proved satisfactory. General operating conditions are better. The maintenance expense necessary from the steam drive has been reduced several thousand dollars beyond expectations. In addition to this three very notable conditions are apparent since electric drives were installed, namely, there is no loss of time, greater cleanliness prevails, and there has been a very material reduction in accidents.

Throughout this installation Westinghouse 440-volt, three-phase low-speed induction motors were used.

ECONOMY OF DIESEL-ENGINE POWER-PLANT OPERATION

Diesel Units Are Used to Advantage in Plant with Steam Turbines, the Turbines Carrying Overload and Steam Heating

EXCELLENT results are shown in the operation of a combined steam-turbine and Diesel engine plant serving a mixed railway, light and power and steam-heating load.

In 1916 the lighting demand increased considerably and the demand for steam heat increased more than 20 per cent. The boiler room had reached the limit of its output and it became essential either to increase its capacity or to obtain energy from some other source. The operating power station equipment at that time included one 750-kw. Curtis turbine, one 500-kw. Allis-Chalmers-Corliss engine, one 325-kw. Murray-Corliss engine, one 1500-kw. Curtis turbine (later replaced by a General Electric bleeder-type turbine) and one 500-kw. Allis-Chalmers turbine. A study of the Diesel engine led to the conclusion that the necessary increase in plant capacity could be obtained without increasing the boiler room capacity by adding engines of this type, with an increase in efficiency of the plant as a whole.

Two Busch-Sulzer four-cylinder, vertical, type-B, 500-hp., 200-r.p.m. Diesel engines were, therefore, installed in August, 1916. One is direct-connected to a 357-kw., 2300-volt, 60-cycle, three-phase alternating-current generator and the other to a 350-kw., 550/575-volt direct-current generator. The guarantees for these engines provide that with a net load of from 500 b.-hp. to 250 b.-hp. the fuel-oil consumption will not exceed 6 gal. to 7.4 gal. (23 l. to 28 l.) per 100 b.-hp.-hr. for the two loads mentioned respectively, the fuel oil to have a heat value of not less than 18,500 B.t.u. per pound, specific gravity at 60 deg. Fahr. (15.5 deg. C.) not higher than 20 deg. Beaumé and not lower than 40 deg., with residue not more than 10 per cent. The speed variation from no load to full rated capacity is not to exceed 2½ per cent from mean.

In November, 1917, one McIntosh & Seymour four-cylinder, vertical-type, 500-hp., 164-r.p.m. Diesel engine was installed. This is direct-connected to a 350-kw., 550/575 volt direct-current generator. The maker guarantees that this engine when carrying between full and one-quarter net load will consume fuel oil of a heating value of not less than 18,500 effective B.t.u. per pound, not to exceed a range between 0.408 lb. and 0.628 lb. (0.19 kg. and 0.285 kg.) per brake-horsepower per hour. The speed variation is guaranteed not to exceed 3 per cent from mean for normal variations in load, and the consumption of lubricating oil is not to exceed 2½ gal. (9.5 l.) per day.

The alternating-current Diesel-engine unit operates in parallel with the 1500-kw. turbine, and after midnight during the summer season when there is no heating it carries the load. It also frequently carries a railway load by conversion through a motor-generator set, but it was installed as an alternating-current unit so that it could carry the lighting load after midnight. The direct-current "Diesels" operate in parallel with the direct-current steam engines and motor-generator sets.

The power plant log sheets show that the Diesel unit which operated most nearly at constant full load gave the best efficiency in kilowatt-hours generated per gallon of fuel oil consumed. This unit generated an average of 10.7 kw.-hr. per gal. of fuel oil and produced an average output of 303 kw.

The accompanying table gives data on the operation of the plant for the years 1915 to 1918 inclusive.

OUTPUT AND COSTS OF OPERATION OF POWER PLANT

	1915	1916	1917	1918
Kilowatt-hours generated	10,776,910	11,531,890	12,613,994	12,907,625
Kilowatt-hours used by railway	6,161,741	6,194,657	6,180,776	6,076,431
Kilowatt-hours used for light and power	4,615,169	5,337,233	6,433,218	6,831,194
Pounds of steam sold	68,588,000	83,499,000	92,728,700	75,643,000
Kilowatt-hours generated by steam	10,776,910	10,062,180	8,309,057	8,291,539
Tons of coal used	38,411.51	42,652.19	35,736.17	31,110.43
Average cost per ton	$2.87	$3.50	$4.59	$4.96
Pounds of coal per kilowatt-hour	7.13	8.48	8.60	7.50
Cost of coal per kilowatt-hour, cents	1.02	1.48	1.97	1.86
Total cost of coal	$110,339.57	$149,271.05	$163,938.99	$154,329.60
Kilowatt-hours generated by Diesel engines	None	1,469,710	4,242,377	4,616,086
Gallons fuel oil used	None	136,664	395,568	427,967
Average cost per gallon of oil, cents	None	3.14	3.70	5.66
Kilowatt-hours generated per gallon of oil	None	10.70	10.70	10.70
Cost of oil per kilowatt-hour, cents	None	0.292	0.345	0.566
Total cost of fuel oil	None	$4,294.12	$14,646.77	$24,238.99
Total fuel cost (oil and coal)	$110,339.57	$153,565.17	$178,585.76	$178,568.59
Average cost of fuel per kilowatt-hour, cents	1.02	1.33	1.41	1.38
Wages of power station employees	$20,967.92	$24,797.08	$27,029.13	$39,320.33
Cost of water	7,839.49	9,699.51	7,424.19	8,711.05
Cost of lubrication	1,127.08	2,404.24	3,851.77	4,991.90
Cost of power purchased	317.26	386.32	1,898.75	.....
Miscellaneous expense	1,902.42	2,134.75	2,761.34	3,548.71
Power plant maintenance cost	13,136.66	11,891.43	20,179.56	25,376.53
Total cost of power station operation	155,630.40	204,878.50	241,730.50	260,517.11
Switchboard cost per kilowatt-hour, cents	1.44	1.78	1.91	2.02

It will be noted that during 1917 and 1918 the Diesel engines carried more than one-third the load of the plant. Also that the cost of coal per kilowatt-hour generated in 1918 was 1.86 cents, while the cost of oil per kilowatt-hour generated was only 0.566 cent. Part of this difference is offset by the increased cost of maintenance of the Diesel engines as compared with the steam units and by the fact that the coal cost also includes that of the coal used for heating, but there is an estimated saving of at least 0.9 cent per kilowatt-hour on all energy generated by the Diesel units. As this amounted to 4,616,086 kw.-hr. the saving was more than $41,000 in one year on switchboard cost.

THE greatest problem that faces us to-day is that of having the public understand what the electrical industry is doing for the nation, but in our opinion this undertaking can only be brought about by proving to the individual of this public what the electrical industry is doing for him—what further developments of the electrical industry mean to him in dollars and cents gain, and what a delay in electrical development, due to legislative or other causes, means in dollars and cents loss to his individual business.—*A. E. Wishon.*

Industrial Research in Small Establishments*

Even the Small Manufacturer Should Organize Research Work, Which Is Defined as Any Work Which Enlarges the Technical Horizon of an Industry—A Specific Scheme of Accounting Shows Whether Research Pays

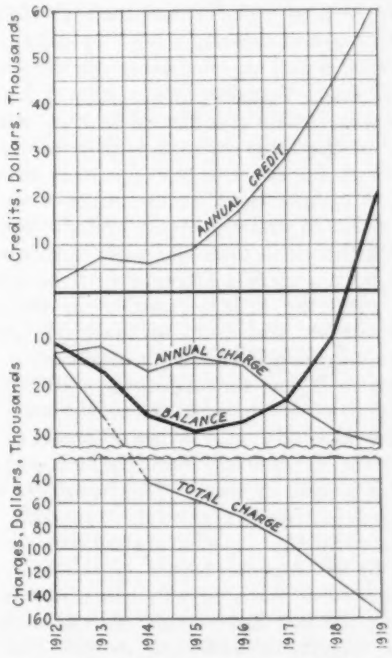
BY M. E. LEEDS
President Leeds & Northrup Company, Philadelphia, Pa.

IN THE past few years, and particularly during the war, research in connection with industry has had much consideration. Most of our large technical societies have devoted sessions to its discussion and have listened to admirable papers on the subject. I hope not to retraverse the ground thus covered. In this audience the vital importance of research to our technical industries would not need arguing even if it had not been amply argued. In these discussions research has been considered as something to be carried on in large well-organized laboratories, and for that reason possible only for large companies, for associated companies managing a co-operative laboratory or for government laboratories and the like. I believe that thinking of research in this way unnecessarily restricts it, and that differently conceived its usefulness to small as well as large establishments would become evident and might result in its large extension.

Research Department Defined

The various activities covered by such titles as "research," "development" and "technical control" are those which should be assumed by a research department in a small business. In order to avoid a cumbersome name for such a department, I want to make a plea for a definition of technical research which some of you may think degrading. Doubtless you are accustomed to thinking of research as an adventure into the realms of the absolutely unknown. A department capable of research in this sense will only be possible in a small business when that business happens to have in it a real scientist. But every technical business—and what manufacturing business is not technical?—is continually confronted with the need of more information than is possessed by its regular staff in regard to processes, characteristics of materials, etc., and if it is to develop realizes that it must find new fields for its product and find new product to sell. The most advantageous solution of problems of this character cannot be left to people who are busied with the routine problems of sales and production. They can best be handled by a staff, even if a very small one, set aside for this purpose. I want to suggest that any department having such functions may be called a research department, and that industrial research may be defined for any given establishment as all that class of work which enlarges the technical horizon of the establishment beyond what is necessary for the routine production and test of its product.

You will note that this will make a sharp distinction between a research laboratory and a testing laboratory. I should not want to see a chemical laboratory, however large and elaborate its equipment or however highly trained its staff might be, called a research laboratory if its sole function happened to be routine analysis and check on the product. On the other hand, I should like to see any little room with even a very meager equipment and staff, perhaps only a single individual, called a research laboratory, provided that the functions of that individual and equipment were solely the improvement of processes, investigation of properties of materials new to the industry, development of new products, etc. And I should want to have it called a research department even if the research were chiefly carried on in libraries or other places for the purpose of bringing information, elsewhere well known, to an establishment to which that information happens to be new. This conception of research widely recognized might be the occasion for many small industries to start research departments, which these industries now regard as possible only for large capital. In this sense many small industries already have individuals with research functions who have other duties as well and do not clearly recognize their research functions. Under these circumstances both the research and the other work suffer, and as the business develops research does not find the best relation to the work as a whole.



METHOD OF CHARTING COST OF RESEARCH WORK. THE BALANCE CURVE SHOWS GAIN OR LOSS RESULTING THEREFROM

In order that research may find its fixed and recognized place in industry it is desirable that it be carefully planned and controlled and that its results be carefully watched. So far as I know, these two conditions of the successful co-ordination of research with industry have not been discussed. Control in the sense of control of the research in the laboratory after it has been decided on has had discussion, and I do not refer to it but to the determination

* Presented at the meeting of American Physical Society in Philadelphia Oct. 11, 1919.

of the subjects which shall be investigated in the research department and the decision as to when the research is completed, or, if it is one that does not lead to satisfactory results, when it shall be abandoned. For some five or six years this class of decisions in connection with our research department has been made by a committee of which the president of the company, the head of the research department and representatives of the sales, engineering and production departments are members. This committee, called the research committee, meets once in two weeks, passes on all new subjects for the research department to handle, listens to reports on the progress of the work in hand and passes on recommendations in regard to the conclusion or discontinuance of work. In this way the work of the research department is well co-ordinated with the needs of the business as a whole. As a further factor in co-ordination the head of the research department is one of the board of directors and sits on the executive committee. The research committee has nothing to do with the internal administration of the department, which is left entirely to its own staff.

Records of the results of a research department can best be kept by the accounting department. It is just as important to know the cost of research as of any other department, and, as in other cases, the usefulness of the record depends to a very large extent on its subdivision. It is worth while to know what investigations contribute to business success and what ones do not.

Accounting for Research Department

Some years ago we worked out a plan of determining research cost and making credits to the department which has given us much valuable information. Each investigation undertaken has its cost record kept by the accounting department in the same way as with a production order. We, of course, do not ask our research men to register their time on a time clock or anything of that kind, but we do ask them to make a memorandum of the work on which they spend their time and turn in to the accounting department once a week a statement of the distribution of their time over the orders running in the department. Similarly, expenses and costs of materials are kept, and when an investigation is closed its total cost is determined. If it happens to be one that has to do with manufacturing processes, such as test of new materials, etc., or development of new methods, it is either charged to general expense or to the expense of some particular product. If, however, it is a piece of work which results in the development of a new instrument or product for sale, it is treated in the same way that a new instrument developed and brought in by an outsider would be. The research committee decides how much royalty can properly be charged to the cost of the instrument, and then as each instrument is made the royalty is added to its cost and is credited against its cost account in the research department. In that way a continuous record of the usefulness of the research to the business is available. In cases of minor importance it is customary to discontinue credits when the cost has been covered. In cases where new products result they are allowed to run on indefinitely. Successful developments accumulate royalties that more than pay for the cost of their research and offset the costs of work that leads to nothing. The diagram shows the relation of annual and accumulated costs of research to the annual and accumulated credits since the department was given a distinct place. In a little over six years the total credits had equaled the total charges and the balance went to the credit side. On the books the account is closed out each year to profit and loss. It is carried forward as a memorandum account only. In the earlier years of the record the total volume of business done by the company was but a few hundred thousand dollars per year.

To summarize, I am making a plea for a conception and organization of research which will allow it to emerge as a distinct department in any growing technical business and take its proper place just as sales, production and accounting do. Any technical business ambitious to grow and render worthy service must in some way avail itself of research. Kenneth Mees and others have pointed out how industry in the past has developed around invention and research, although the distinctiveness of these functions was not clearly recognized and in many cases they were not directly associated with the business which profited by them. Certainly an enterprise will have a more worthy and normal growth if its need for research is early and clearly recognized, and the research department will more easily find its proper relation to the business as a whole if it is established early and its place and functions are defined. After a business has assumed large proportions and research functions are distributed in scattered manufacturing and engineering departments, it is difficult to gather them together and co-ordinate them.

Let me remind those of you who may think this conception of research degrading that the present scientific limitation of the word is modern and confined to the exact sciences. The Century Dictionary gives it definitions in this order:

1. Diligent inquiry, examination or study.
2. Laborious or continued search after facts or principles.
3. Investigation.

So I think the definition which I propose does not violate good usage. Even if it did, would not the possibilities of development and usefulness to industry which this definition allows justify it in the same way that Bryce, in his "American Commonwealth," writing of the third quarter of the last century, said that the application of the name "university" to many institutions which were no more than colleges, or in some cases high schools, was a favorable sign because it showed an aspiration, and that where the aspiration existed the reality would follow?

INTERCONNECTION OF PLANTS COMPLETED IN MOBILE, ALA.

Mobile Electric Company Will Buy Energy from the Chickasaw Shipbuilding Company and Conserve Capital

A transmission line by means of which the Mobile (Ala.) Electric Company will secure electrical energy from the Chickasaw Shipbuilding Company has been completed and placed in operation.

As a result of power demands made upon the company during the past two years it had become necessary to provide additional capacity involving a new power house at an outlay of $1,000,000 or more capital. Instead, T. K. Jackson, manager of the company, saw the possibility of purchasing additional power from the shipbuilding company and an agreement was entered into whereby the Mobile company is to receive one-half of its energy demand from the shipbuilding company on a 3000-kw. peak-load basis. The company is now serving a power demand nearly twice as great as in 1916, chiefly owing to shipbuilding activity.

Readers' Views and Comments

Transformer Insulation for Operation at 220,000 Volts

To the Editor of the Electrical World:

Sir: In the editorial on "Problems of 220-Kv. Power Transmission," which appeared in the Electrical World of June 28, 1919, doubt was cast on the ability of transformer designers to cope at present with the problem with assurance of commercial success. The editorial states that "No one knows how well existing transformer insulations will stand the greatly increased dielectric stresses."

The writer desires to call attention to the fact, doubtless fully appreciated by you, that transformer designers have accurate knowledge of the dielectric stresses which the various insulations used can stand continuously in service, and that as long as transformers are designed so that these stresses are kept at safe values, transformers, so far as the insulation is concerned, can be considered commercially sound and practicable. A transformer for 220,000 volts does not differ from a 50,000-volt transformer in reliability, provided that the insulations are both worked at the same intensity. The higher voltage simply means greater space between conductors and more insulation. Insulation designers are now so familiar with the laws of stress variation with voltage and spacing at high voltages that there is no excuse for building one in which the insulation is overstressed.

Pittsfield, Mass. W. S. Moody.

Design of High-Power Arc Converters

To the Editor of the Electrical World:

Sir: In connection with the editorial on the development of arc radio transmitters in the Electrical World of Sept. 6 it may be of interest to your readers to know that a paper on the technical phases of this subject will appear shortly.

In 1918 the writer, then chief electrical engineer of the Federal Telegraph Company, prepared, at the request of the United States Navy Department and with the assistance of Mr. Anderson and other engineers of the Federal Telegraph Company, a complete report on the design of modern high-power arc converters. This report, which embodies both theoretical analysis and actual experimental data collected over a period of six years, during which arc converters were developed from a capacity of 30 kw. to 1000 kw., shows that modern arcs frequently reach a flame efficiency of approximately 48 per cent with 50 per cent as a theoretical maximum. Thus, with 500 kw. input to the arc flame, about 240 kw. is delivered to the antenna system as radio frequency energy. The overall efficiency is somewhat less than the foregoing, because of the kw. required to maintain the transverse magnetic field.

The causes of harmonics are fairly well understood, and in the report, means for keeping them at a minimum are considered. This paper, held confidential during the war, has been released by the Navy Department for publication in the *Proceedings* of the Institute of Radio Engineers.

Barberton, Ohio Leonard F. Fuller.

Saving Coal by Steam-Electric Heating

To the Editor of the Electrical World:

Sir: In days past, when coal was cheaper than gravel is to-day, the idea of saving coal did not loom up to the extent it does now. If coal was mined every year with a reasonable surplus for emergency and assigned to the proper places for use, any amount of waste would be eliminated in coal pit fires and storage deterioration. Coal has been on the market which has been stored long enough to have lost more than 50 per cent of its heating value. To regulate the mining, selling and shipping would be no small undertaking, but the necessity for such an action is beyond argument, for the assigning of coal to places where it is most adapted is one step in the direction of getting the most out of a pound of combustible.

To regulate the coal in mine output and distribution would be conserving our coal supply, but while this is vital there are other means of saving fully as important. The greatest saving in fuel that can possibly be attained is to assimilate the small coal piles into larger piles and promote efficient operation. This can be accomplished only by municipal or co-operative central heating plants. It does not take much thinking to see that we are wasting millions of tons of coal through small users throughout the entire country, and with the remedy close at hand we still keep on wasting it. There should be official action to promote the building of plants for the welfare of communities and the conservation of fuel. The possibility of a combination of steam and electric heating is the point in view. A 100-hp. total of boiler capacity will supply approximately 6000 sq. ft. radiation in electric heating and about 12,000 sq. ft. radiation in exhaust steam. This system is used to-day in several plants as an electric load for power, and exhaust steam is used for heating, but utilizing this load for electric heating has as great a value as using it for power; the main factor is to operate the unit at full load.

For instance, a building to be heated with 20,000 sq. ft. of radiation would take approximately 150 hp. in boiler capacity for direct heating. The cost of this heating would in most localities be about $7,000 for the heating season with coal at $8 per ton. On the other hand, if a combination of steam and electric heating were installed, about 40 per cent of the total radiation would be taken care of by the electric generator and 60 per cent with exhaust steam. It can readily be seen that a saving in the coal pile will take effect of from 30 to 40 per cent, all according to the efficiency at which the plant may be operated.

There are at present a number of electric radiators in the market of different efficiencies. Tests are also being made of a vacuum-steam-electric radiator which promises a great future for electric heating. In tests so far it has been possible to raise 2 lb. of steam in ten minutes with a current of 1000 watts in 80 sq. ft. of radiation. There are also hot-water heaters on the market which can be modified or redesigned for hot-water heat. A watt will give as much heat if the right metal is used for resistance, but perfect circulation will give efficiency. The more rapidly the water circulates through the heating elements the more heat is absorbed in stages from the heat unit; hence, the losses being less, the output increases.

There has been a lot of talk of conserving fuel and much apparatus has been installed to determine cost, but the main effective way to conserve has to a great extent been neglected. T. L. Thorsen.

Menomonie, Wis. Chief Engineer the Stout Institute.

STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

CIRCUMSTANTIAL EVIDENCE IN OPERATING ACCIDENTS

Inaccuracies in Operators' Reports Become Apparent on Analysis of the Happening—System Operator's Usefulness

Two substations on a large system were fed through outdoor transformers and switchgear from two 44,000-volt, three-phase, 60-cycle transmission lines that connected two generating stations 15 miles (24 km.) apart, as shown in the single-line diagram. During a heavy rain one evening the operator at Substation No. 2 reported

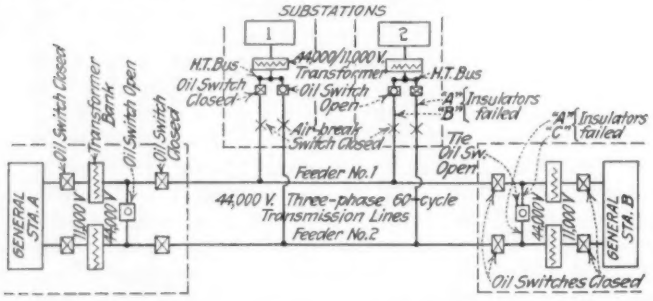


DIAGRAM SHOWS EFFECT OF PARALLELING FEEDERS WITH GROUND CONNECTORS ON DIFFERENT PHASES

that an "A"-phase insulator on feeder No. 2 was spilling over. He was denied permission to parallel the feeders and was ordered to drop his load from feeder No. 2 and start up again on feeder No. 1.

A few minutes later there was a violent disturbance on the system. The switches on feeder No. 1 automatically opened at Stations A and B and would not hold until the air-break switches were opened on the taps of both feeders into Substation No. 2. The two feeders previously had not been in parallel at any point. Substation No. 2 was the only point at which switching had been done. Although this operator maintained that he had opened the oil switch of feeder No. 2 before he had closed the one on feeder No. 1, damaged insulators were found after the trouble on the "A" phase of feeder No. 2 at Station B and at Substation No. 2, on the "B" phase of feeder No. 1 at Substation No. 2, and on the "C" phase of the same feeder at Station B. This was fairly strong evidence against the truth of the operator's report because grounds on opposite phases of different feeders would have caused no trouble unless the feeders were in parallel. Furthermore, the feeders could not both be energized until the air breaks on them were opened at his substation, proving that the feeders were in parallel there. This condition was also indicated by the breakdown of insulators on opposite phases to the original failure on the feeder that had shown no trouble before switching.

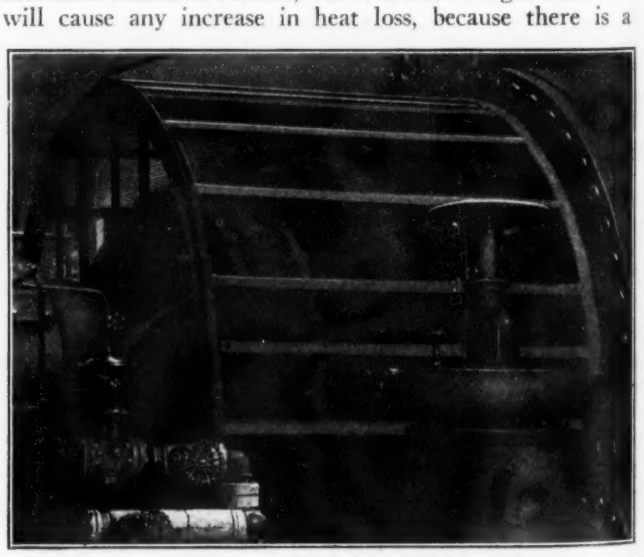
Routine operation in central-station systems has advanced to a degree of efficiency where every happening is thoroughly analyzed by specialists in operation with the view to preventing a repetition of an undesirable happening of the occurrence of a similar one. The system operator who in handling each operating event in its entirety is thus enabled to visualize it in all its phases endeavors to make his report of the event a logical history. In comparison with such a report contradictory reports of individual operators make a poor showing. The [illegible] who falsifies his report is soon found out and the [illegible] distrusted.

G. J. FRANCIS.

TURBINE HEAT INSULATION PLACED ON WIRE GUARD

By This Means the Entire Insulation Can Be Easily Removed in Sections and the Turbine Inspected and Repaired

To facilitate repair work, the heat insulation for the turbines in the River station of the Buffalo (N. Y.) General Electric Company is being made up as a removable cylindrical framework of steel and wire covered with magnesia, instead of in the usual manner in which magnesia block is laid directly on turbine casing and made to conform closely to it. This makes it an easy matter to work on the turbine and eliminates the expense that would be necessary if each strip of magnesia had to be removed separately. Of course the use of the framework gives an increased radiation surface, but it is not thought that this will cause any increase in heat loss, because there is a



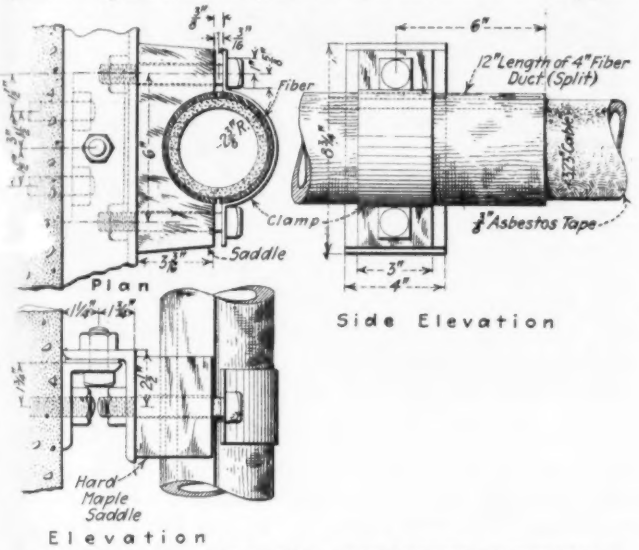
REMOVABLE CYLINDRICAL FRAMEWORK COVERED WITH MAGNESIA FOR HEAT INSULATION OF TURBINES

dead-air space between the casing and the housing, which is of itself a poor conductor of heat. When repairs have to be made or the interior of the turbine has to be inspected the framework carrying the insulation can be removed in sections. A sheet-iron covering protects the insulation.

A WALL-CLAMP SUPPORT FOR VERTICAL CABLES

In Tunnels the Cables Are Firmly Held in Clamps Consisting of Metal, Wood and Fiber—Space Between Centers About 3 Ft.

By using clamps consisting of a combination of metal, wood and fiber a central station in the Middle West has arrived at a very satisfactory method of supporting vertical cables in the tunnels—one which obviates any possible damage to the cable sheath. The 3.23-in. (82-mm.) cable, which is operated at 12,000 volts, is covered with a ⅜-in.



DETAILS OF CLAMP FOR SUPPORTING VERTICAL CABLE RUNS

(9.6-mm.) layer of asbestos tape over its entire run in the tunnel and at each clamp is incased in a 12-in. (30-cm.) length of 4-in. (10-cm.) split-fiber duct. This structure is held rigid against a saddle of hard maple by means of galvanized-iron clamp ⅛ in. (3 mm.) thick. The saddle and clamp are fastened to the vertical wall by means of a 5-in. by 3-in. by ⅜-in. (12.7-cm. by 7.6-cm. by 0.96-cm.) angle iron and a 3-in. by 2.5-in. by ⅜-in. (7.6-cm. by 6.3-cm. by 0.96-cm.) lug angle. Bolts, ¾-in. (19 mm.) in diameter, hold the clamp together as shown. The vertical spacing of the hangers is 3 ft. (0.9 m.), and the conductor spacing is 10 in. to 12 in. (25 cm. to 30 cm.).

WALL MAP FACILITATES LOAD DISPATCHER'S WORK

Portland (Ore.) Company Has So Charted Its Lines That Detailed Information on Switches and Connections Is Had by a Glance

A map that enables one to visualize quickly the company's high-tension system has been used very effectively by the Northwestern Electric Company of Portland, Ore., from the chief executive down to the salesman for tracing the nearest distribution line to a prospective customer.

The map is about 6 ft. (1.8 m.) square, made of "Compo-board" painted white and framed. On it are laid off in ink all the company's transmission, tie and primary distribution lines in the Portland district to a scale of 400 ft. to the inch (48 m. = 1 cm.). The location of all air-break switches is marked on the map, and round-headed colored pins are used to indicate whether the switches are closed or open. The same indications are used as on the station switchboard; *i.e.*, a red-capped pin indicates a closed switch and a green pin shows an open switch.

Four classes of lines are indicated on the map, namely, high-tension transmission lines, 11,000-volt station lines, 11,000-volt primary distribution lines and 2400-volt primary distribution lines. A different color is used for ruling in each class of lines. Narrow strips of paper on which street names have been typewritten are pasted on the map to indicate what streets the lines follow.

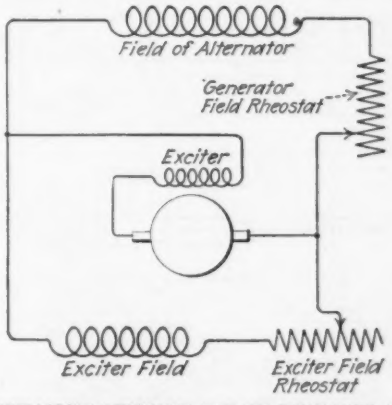
The most convenient system of numbering the air-break switches for reference was to use the street number of the nearest residence and the line voltage; for example, "630 Hoyt 2400" indicates an air-break switch on the 2400-volt primary system in front of 630 Hoyt Street.

An important function of the map is to show just what loop connections are possible on all distribution lines and to show by means of the pins just what the situation is in regard to interconnections. To make this possible the map is carefully and constantly kept up to date. In case of trouble the superintendent, who also fulfills the function of load dispatcher, can tell by a glance at the map just what sections of the line to cut out and just what orders must be given to patrolmen.

RHEOSTAT MISADJUSTMENT CAUSES EXCITER TO HEAT

Unsatisfactory Condition Existed When Resistance Was in Series with the Alternator Field and Exciter Field Resistance Was Cut In

Although the amount of resistance in series with the field coils of an alternator and its exciter respectively may be properly apportioned so that the desired voltage is obtained, the most desirable proportions of alternating and exciter field resistance are not necessarily assured thereby. In fact, there are several relations of these two resistances which will produce the desired voltage on the part of the larger machine. The most economical adjustment, how-



MORE RESISTANCE SHOULD BE IN EXCITER FIELD AND LESS IN ALTERNATOR FIELD CIRCUIT FOR ECONOMY

ever, is obtained when resistance in the alternator is zero because this condition assures the minimum energy loss. For this reason the voltage of the alternator should be kept at normal by the adjustment of the exciter field rheostat as much as possible.

This problem was encountered by the author recently

when he was called upon to investigate the cause of an exciter becoming hot. It was found that the adjustment of the rheostat was exactly opposite that desired. The resistance of the generator field rheostat was all cut in and the resistance of the exciter field rheostat was all cut out. With this condition obtaining the exciter voltage had to be high enough to overcome the voltage drop in the alternator rheostat as well as in the alternator shunt field.

In one instance where this condition was later found to be present the engine driving the exciter was overloaded. By reducing the resistance in the alternator field circuit and increasing the resistance in the exciter field the engine came up to proper speed and the brush voltage of the exciter was reduced from 135 volts to 95 volts, thereby reducing the load about 30 per cent.

At another time when an alternating-current voltage regulator was in service the direct-current magnet coil became extremely hot. The exciter voltage was high and the coil was warm. Again by adjusting the rheostats the voltage was reduced from 135 volts to 75 volts without interfering with the regulating properties of the series rheostat.

As the field current of the alternator was 62 amp. and the difference in voltage was 60, the power saved was 3720 watts. This, in addition to the current which had been required by the shunt field to maintain the higher voltage, produced an appreciable saving.

W. A. Darter,
Superintendent Brenham Electric and Ice Plant.
Brenham, Tex.

TESTING OF INSULATORS UPON THE DEAD LINES

Instrument Used Consists of Long Rod on Which Battery, Spark Coil and Testing Fork Are Arranged for Quick Tests

On account of two serious insulator failures on 110,000-volt lines of the Mississippi Power Company between Keokuk and St. Louis a complete set of all the line insulators was made to forestall further trouble. Both lines were so fully loaded that they could not be shut down excepting on Sundays and nights, and to test any appreciable number of insulators on Sunday would have entailed considerable expense because the line is 144 miles (230 km.) in length. As the megger test is not accurate at night time because of dampness some means has to be evolved for accurately testing the dead insulators at night.

The problem was finally solved by designing and building the instrument shown in the illustration, which is exceedingly simple and easy to use. Upon the handle of the fork of this instrument is mounted an automobile induction coil, the low-tension winding of which is connected in series with a snap switch and three dry cells in the container at the handle end of the testing rod. The testing fork is not designed for use on live lines, so any circuit on which tests are to be made must be taken out of service and protected before the fork is applied to individual units. When the line is ready for test the fork is applied to each unit in any insulator string as shown in the illustration; if the insulator has satisfactory resistance, there is no discharge across the spark gap on the rod.

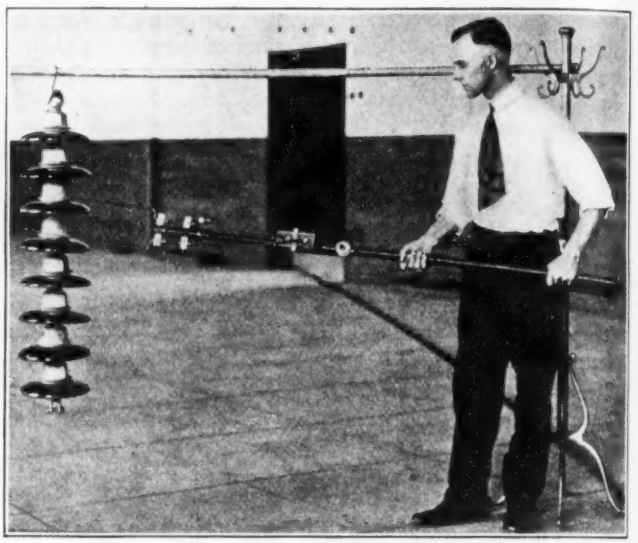
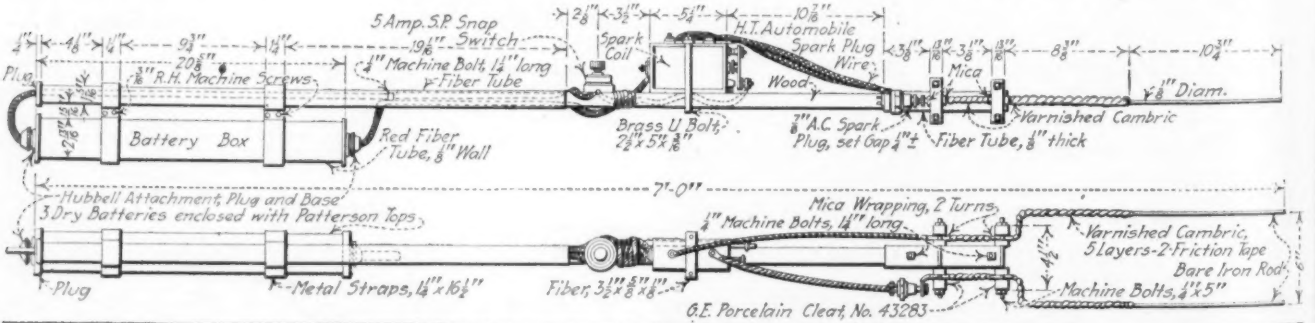


FIG. 1—METHOD OF APPLYING TESTER TO INSULATORS


5 Amp. S.P. Snap Switch
Spark Coil
H.T. Automobile Spark Plug Wire
Mica
Wood
Varnished Cambric
Fiber Tube, ⅛" thick
Battery Box
Red Fiber Tube, ⅛" Wall
Brass U Bolt, 2½" x 5" x ⅜"
⅜" A.C. Spark Plug, set Gap ¼" ±
⅜" R.H. Machine Screws
¼" Machine Bolt, 14" long
Fiber Tube
Plug
Hubbell Attachment Plug and Base
3 Dry Batteries enclosed with Patterson Tops
7'-0"
Mica Wrapping, 2 Turns
¼" Machine Bolts, 14" long
Varnished Cambric, 5 Layers-2 Friction Tape
Bare Iron Rod
Machine Bolts, ¼" x 5"
Metal Straps, ¼" x 16½"
Fiber, 3½" x ⅝" x ⅛"
G.E. Porcelain Cleat, No. 43283

BILL OF MATERIAL FOR ONE INSULATOR TESTING DEVICE

1	Round Ash Stick, 1⅛" Diam., 3'-7½" long	2	Iron Bands, 1¼" wide x 16⅝" long	1	Pc. Flat Fiber, 3½" x ⅜" x ⅛" Strap	2	Ft. Mica Ribbon, 2" wide, $\frac{1}{64}$" thick
2	Hubbell Caps, No. 5420	4	R.H. Machine Screws, ⅜" x 1"	1	Brass U Bolt, 2½" wide, 5" deep x ⅜"	1	Pc. Black Fiber Tube, ⅛" Wall, 8¼" long,
2	Hubbell Bases, No. 5612	4	Nuts for same	2	Nuts and Washers to Fit ⅜" Rod		1⅛" Inside Diam.
1	Battery Box, 2⅜" Diam. 20⅜" long, Red Fiber Tube	1	Black Fiber Tube, ⅛" Wall, 35⅝" long,	1	⅜" A.C. Spark Plug	4	G.E. Porcelain Cleats, No. 43283
1	Plug for End of Battery Box, Black Fiber threaded		1⅛" Inside Diam.	2	R.H. No. 8 Wood Screws ⅜" for Fastening	4	Machine Bolts, ¼" x 5" with 4 Nuts for same
3	Dry Batteries with Patterson Tops	1	Plug for End of Tube, threaded		Switch to Handle	2	Pcs. bare Iron Rod, ⅜" x 26" long
9	Ft. H.T. Automobile Spark Plug Wire	1	Modified "Ford" Spark Coil,	15	Ft. varnished Cambic Tape, ¾" wide	3	Machine Bolts, 1¼" long x ¼" with
1	5 Amp. S.P. 125 Volt Snap Switch		(H.T. separated from L.T.)	10	Ft. Friction Tape, ¾" wide		Nuts for same

FIG. 2—DETAILS OF INSULATOR TESTER

During the period from June 23 to July 26, 1919, 44,000 insulators at dead-end and anchor towers on this line were successfully tested with this device and 2087 units, or 4.74 per cent, were found defective and replaced.

METER CALIBRATOR FOR UTILIZATION IN FIELD

Packed Tightly in a Large Case, the Instrument Maintains a High Standard of Accuracy Over Long Periods

On account of a large number of primary meters situated from ½ mile to 30 miles (1 km. to 50 km.) apart on the Central Power Company's system, this company has found it necessary to arrange some means for carrying a

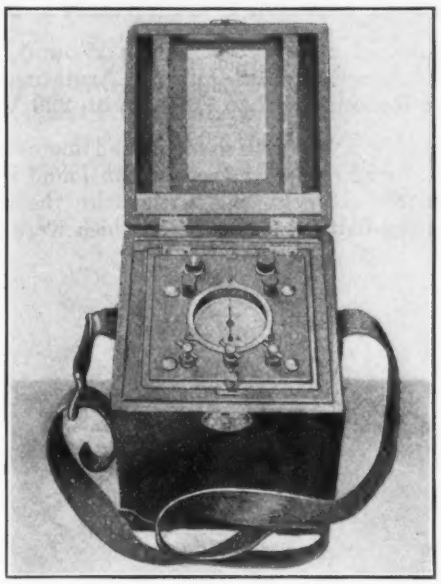


FIG. 1—CARRYING CASE FOR PORTABLE TESTING METER

calibrator the accuracy of which can be maintained for at least two weeks in the field. For this purpose the General Electric type I B-5, 110/220 volt, 3-10-amp. calibrator was placed in an extra Fort Wayne type I 13-5 calibrator case, which was somewhat larger than the instrument. This allowed the insertion of soft felt strips on the bottom, sides and cover of the casing as shown. On one side there was a space of ¼ in. (20 mm.) and on the other side a space of 1½ in. (35 mm.).

After one week of traveling over very rough roads in the field, the calibrator packed in this manner was thoroughly tested in the laboratory and found to be in good condition. Indeed, even a longer period in the field failed to vary its accuracy as much as 1 per cent. Before this method was used it had been found necessary to adjust the meter in the laboratory as often as once a week.

M. F. Smalley,
Meter Superintendent Central Power Company.
Newark, Ohio.

GRAPHICAL INTERPRETATION OF STATIC CONDENSER ECONOMY

Comparison of Operating Costs with Those of Synchronous Condenser—Benefits Gained by Static Condenser Installations

The total yearly operating expenses of static and synchronous condensers, shown in the curves produced here, comprise two items, one a capital charge at some assumed percentage of purchase price of the equipment and the other representing the cost of furnishing the losses of the equipment at an assumed number of hours' full load operation per year charged at a stated price per kilowatt-hour. From these curves, which were included in a paper presented by O. C. Roff of the General Electric Company before the convention of the Pennsylvania Electric Association, it can be seen that the static condenser is particularly economical when used in sizes below about 1000 kva. Above this point the synchronous condenser becomes more economical in most cases. Economical designs of static condensers have not been produced for direct operation at 550 volts or below, and it is therefore necessary to utilize auto-transformers for stepping up the potential for the condenser units. Static condenser outfits become correspondingly expensive when used on frequencies less than 40 cycles.

The characteristics of a static condenser which render it particularly desirable as a power-factor corrective device are as follows: Total absence of running parts, which insures practically noiseless operation; that minimum attendance is necessary; that they can be installed in remote locations or distributed over the system in small units so that transmission losses of the wattless component can be eliminated; that no expensive foundations are necessary, and the high efficiency of the apparatus.

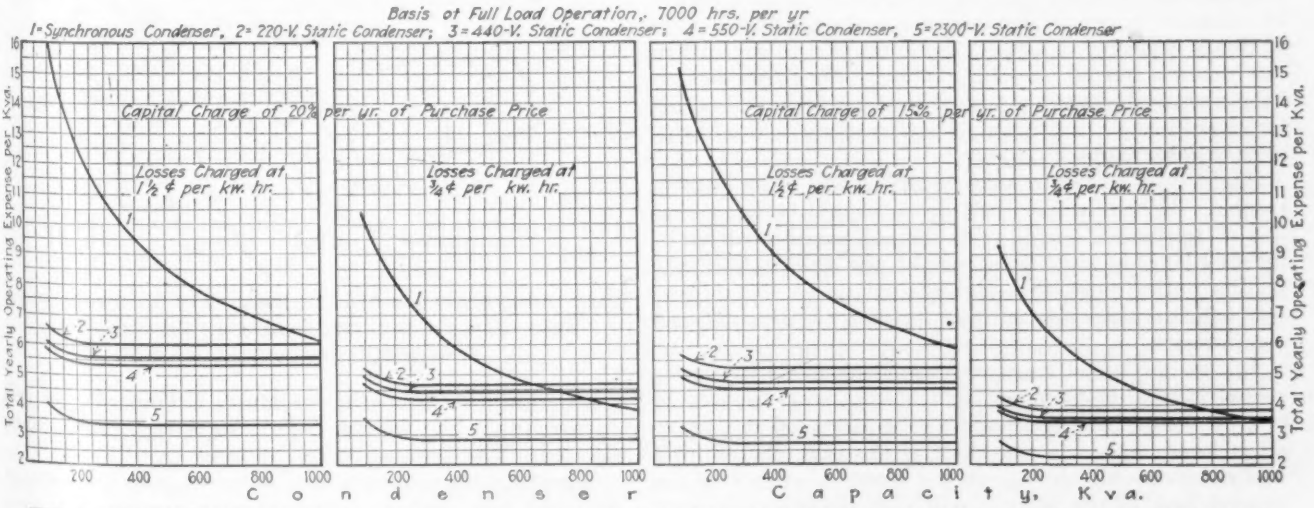

Basis of Full Load Operation, 7000 hrs. per yr.
1=Synchronous Condenser, 2=220-V. Static Condenser; 3=440-V. Static Condenser; 4=550-V. Static Condenser, 5=2300-V. Static Condenser
Capital Charge of 20% per yr. of Purchase Price
Losses Charged at 1½ ¢ per kw. hr.
Losses Charged at ¾ ¢ per kw. hr.
Capital Charge of 15% per yr. of Purchase Price
Losses Charged at 1½ ¢ per kw. hr.
Losses Charged at ¾ ¢ per kw. hr.
Total Yearly Operating Expense per Kva.
Condenser Capacity, Kva.

FIG. 2—STATIC CONDENSERS USED IN SIZES UNDER 1000 KVA. ARE MORE ECONOMICAL THAN SYNCHRONOUS

INDUSTRIAL APPLICATIONS

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

EFFECTS OF BEARING TROUBLE IN PAPER AND PULP MILLS

Causes and Methods of Remedying Ordinary Troubles and Suggestions for Obviating Difficulties Which Curtail Production

Bearing trouble, if detected and remedied, is not very serious except that on an important drive it may hold up production. Usually, however, bearing trouble develops rapidly after a certain stage is reached, and in the pulp and paper machines it is liable to allow water to drop on the pole pieces and subjects the windings to increased temperature due to friction. In many cases the coils are burned out, and in nearly every case the life of the windings is shortened.

Frequent causes of bearing trouble are dirt or grit in oil wells, excessively tight belts and sticking oil rings. In addition, if the end bells of small motors are not installed correctly difficulty will arise on account of the shaft being out of line.

In dirty and gritty places it is almost impossible to keep the ordinary induction motor bearings clean. About the only solution for this condition is to inspect the boxes closely, drain the oil off at frequent intervals, clean out the well with kerosene, and refill with new oil. The old oil can be filtered and used on slower-moving machines.

In spite of good and regular treatment the boxes are apt to heat between weekly inspections, but it is possible to work the wells with kerosene and refill while the motor is in operation by draining the box and pouring in kerosene at the same time. In stubborn cases it may be necessary to add a heavier oil, but if this is done care should be taken to change to light oil as soon as the box is cool. If this is neglected it may cause the oil ring to stick when the motor is started up cold. Some of the recent motors have the well covers screwed down, which makes for inconvenience of inspection, but the construction helps greatly in keeping out the dirt.

Tight belts and short vertical drives will cause bearing trouble. Where possible belt drives should be horizontal and of reasonable length with the pull on the bottom of the belt. This allows the sag of the belt to hug the smaller pulley more, thus giving a maximum contact surface which enables the belt to function properly with less deterioration.

In the case of oil rings sticking, the trouble is usually caused by the oil becoming foul and gummy—something new oil would have prevented—or it may be that a heavy oil is being used. If the latter is the case, the oil ring will cause trouble soon after the motor is started as the natural heat of the bearing will thin the oil while running. When cold it may stiffen so that it holds the ring. For this reason every motor should be inspected before starting.

W. B. SMITH,
Aroostook Pulp and Paper Mill.
Van Buren, Maine.

CHANGING THE VOLTAGE OF A DIRECT-CURRENT MOTOR

Field Coils of a Six-Pole, Shunt-Wound, 110-Volt Motor Are Rewound, but the Armature Coils Are Reconnected to Operate on 220 Volts

In changing a 110-volt shunt-wound motor to operate on circuits of 220 volts, the repair man found it necessary to rewind the six field coils with twice the number of turns and one-half the size of wire which were previously

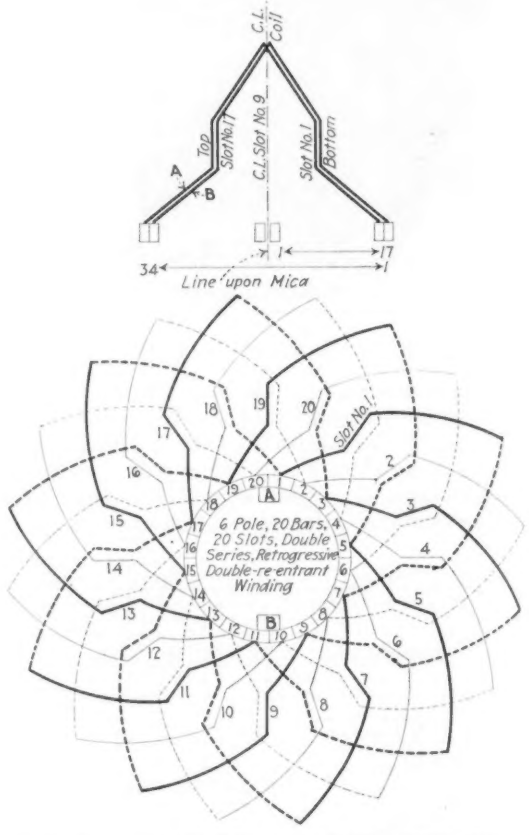


FIG. 1A AND 1B—110-VOLT ARMATURE WINDING DATA AND 110-VOLT DOUBLE SERIES RETROGRESSIVE, SINGLE-RE-ENTRANT WINDING

used. The change in the armature, although it did not require rewinding of the coils, was a trifle more complicated. The process was as follows:

The 110-volt armature had 100 slots, 100 commutator bars and 100 one-turn open-end coils, consisting of two ½-in. by $\frac{1}{16}$-in. (13-mm. by 1.6-mm.) copper conductors in parallel. The pitch of the coil on the armature was 1-17 and the throw of the leads on commutator from bar 1 to bar 34. In can be seen from Fig. 1a that the 110-volt winding is a single series or wave, single reëntrant, retro-

gressive winding, with two paths or circuits of fifty coils per path.

The first thought in changing from 110 volts to 220 would be to double the voltage, double the number of armature conductors or turns in series per path and decrease the area of copper per conductor one-half. As the original coil consisted of one turn of ½-in. by ⅛-in. (13-mm. by 31-mm.), copper wound on edge, to make a two-turn coil, using the same commutator, would mean making a coil out of ¼-in. by ⅛-in. copper strap wound on edge. This would not be an easy coil to make and insulate. Discarding the two-turn coil idea and investigating the 110-volt armature winding, it was found that the individual straps or coils (*A* and *B*, Fig. 1a) were insulated from each other, forming practically 200 single coils of ½-in. by ⅛-in. copper (being connected two in parallel to the commutator as shown in Fig. 1a), and that the insulation was in first-class condition. In fact, it stood standard test voltage to ground and between straps *A* and

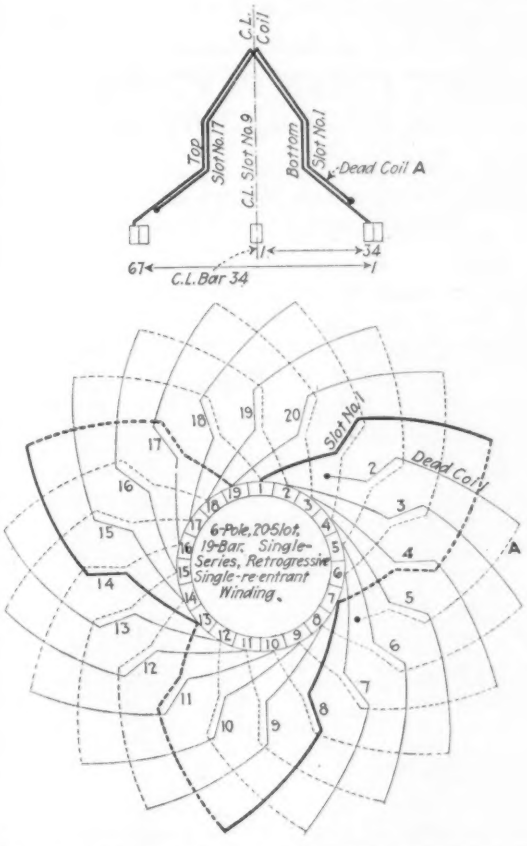


FIG. 2A AND 2B—220-VOLT ARMATURE WINDING DATA AND 220-VOLT SINGE-SERIES RETROGRESSIVE SINGLE-RE-ENTRANT WINDING

B in Fig. 1a, the last test being made after the commutator was removed and the ends separated.

Having 200 good coils on the armature, which is the required amount for 220 volts, the problem then became a question of whether a 200-bar commutator and 200 coils could be connected into a single-series retrogressive winding. If this could be done, a commutator having the required number of bars could be obtained, and then without disturbing the armature coils it could be inserted in place of the old commutator.

Applying the single-series armature winding formula to the 200-bar winding there results: $B = (P/2) \times T + 1$, where B = number of bars and coils, P = number of poles, T = throw or pitch of leads on commutator. Then, for this winding, $B = 200$ and $P = 6$, so that $200 = (6/2) \times T + 1$. Therefore $T = (200/3) = 66 + 2$. This would make the pitch of leads 1 and 67, which would form a double-series retrogressive winding of four paths of fifty coils per path. As this is the same as the original winding, it would only develop 110 volts. It is visually shown in Fig. 1 why 200 bars cannot be wound single-series retrogressive, the diagram being reduced to one-tenth scale, *i.e.*, twenty bars and slots. Using the formula in this case, T will be 6 and the throw will be 1 and 7. The remainder of 2 means a series of $P/2$, or three, coils would encircle the commutator and end two bars behind the starting point. Starting at bar 1 (Fig. 1), through coil in slot 1 and 4 to bar 7 — 13 brings the coil end at bar 19, whereas a single-series winding should end up one bar ahead or behind the starting point, one bar ahead for a progressive or one bar behind for a retrogressive winding. Upon further investigation the winding will be found to continue from bar 19 to 5-11-17-3-9-15 to bar 1, the starting point, passing through ten coils before closing on itself.

The diagram also shows that there is another series of ten coils interplaced between the series shown in the medium black lines, or starting at bar 2, then to 8-14-20-6-12-18-4-10-16 and then back to bar 2, the two windings being entirely separated and consisting of ten coils each. Then if brushes be placed as at *A* and *B*, brush *A* will be in contact with bars 20 and 1, and brush *B* with 10 and 11, so that the winding will be divided into four parallel paths of five coils per path (fifty coils per path for the 200-bar winding). The paths are from brush *A* bars

1-7-13-19-5-11
20-6-12-18-4-10

these coils being followed around the armature in a clockwise direction to brush *B*. The other two paths starting at brush *A*, bars 1 and 20 are followed through counterclockwise, *i. e.*, from bars

1-15-9-3-17-11
20-14-8-2-16-10

to brush *B*. From the above it is obvious that even if there were 200 coils in the armature it would still develop 110 volts, there being two separate windings of 100 coils each, or four paths of fifty coils per path, which is the same as originally.

Two hundred bars and coils can be connected into a single-series progressive winding by making the throw of leads 1 and 68, or 1 and 8, since (Fig. 1) this would permit a series of three coils to end up one bar ahead of the starting point. As the original winding was retrogressive, to change it to progressive would reverse the direction of rotation of the armature, which eliminates the progressive winding for the time being.

Trying the formula, to find the number of bars nearest to 200 that can be wound single-series retrogressive, we have $B = (P/2) \times T + 1$, or $3 \times 66 + 1 = 199$ bars. This arrangement will give the proper throw of leads on the commutator, being 1 to 67, and form a single-series retrogressive winding of two paths of 100 coils per path, which is what is required for 220 volts. Fig. 2a shows the 220-volt winding data as given to the

armature winder, and Fig. 2b shows the 220 winding reduced one-tenth, *i.e.*, nineteen bars and nineteen coils, one coil being dead-ended as shown at *A*. Investigating Fig. 2, it will be seen that a series of three coils starting at bar 1 and going to bars 7-13-19 will end one bar behind the starting point, and that the winding continues on to bars 6-12-18-5-11-17-4-10-16-3-9-15-2-8-14, then back to bar 1, passing through all the nineteen coils.

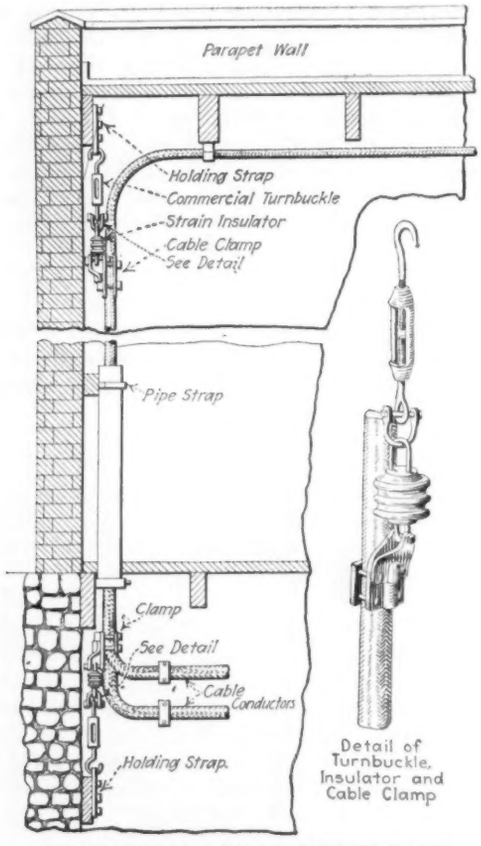
A 199-bar commutator was then pressed into place, and the winding connected as per Fig. 2a, one coil being dead-ended as at *A*, in that illustration. After being assembled the motor was subjected to a running test at 220 volts. It has been running satisfactorily since.

New York, N. Y. C. A. Johnson.

VERTICAL CABLES HELD TAUT BY TURNBUCKLES

Cables Are Protected by Means of Wrought-Iron Conduit Where They Pass Through Floors—Special Strap Holds Turnbuckles in Position

By the use of turnbuckles and cable clamps several 500,000-circ. mil. cables which run vertically through several stories of an industrial plant are held taut. Strain



TURNBUCKLES KEEP CABLES TAUT

insulators are inserted to provide insulation at the dead ends, and wrought-iron conduit tubes protect the cables from mechanical injury where they pass through the floors. This system obviates the use of copper buses, which usually require a shaft and take up more space.

St. Louis, Mo. Raymond H. Weaver.

PAINTING FUSES FOR PURPOSE OF HELPING PRODUCTION

Will Eliminate Delay in Replacing Fuses Where Label Has Fallen Off and Other Marks Are Obliterated

The suggestions on fuse marking made recently by T. H. Day of Hartford, Conn., before the convention of the National Association of Electrical Inspectors might be applied in a little different way by industrial plants to facilitate maintaining uninterrupted service. Usually when fuses must be replaced there is some delay in determining their size because the label may have fallen off or the marking become otherwise obliterated. If the industrial plant electrician will put a dash of paint on each fuse as it is received from the factory the operators will be enabled to tell by its color what size fuse is necessary, and selection of the correct size fuses will be facilitated.

New York, N. Y. L. Henry.

ELECTRIC DRIVE FAVORED IN REFRIGERATION PLANT

Analysis of Cost of Five Types of Installation Shows Synchronous Motors and Compound Compressors to Be Economical

In order to determine accurately the best type of machinery to install in a new refrigerating plant, Ophuls, Hill & McCreery, Inc., consulting engineers of New York, made a detailed analysis of the initial and operating costs. This plant was to have a total capacity of 600

TABULATION OF OPERATING EXPENSES

Type of Plant*	No. 1	No. 2	No. 3	No. 4	No. 5
Cost of plant	$280,000	$240,000	$240,000	$160,000	$160,000
Power or fuel per year (tons and kw.)	8,730	5,075	4,475	5,758,700	5,026,700
Cost power or fuel per yr.†	$27,500	$15,986	$14,100	$45,000	$41,250
Chief engineer	2,500	2,500	2,500	2,500	2,500
Three operating engineers	3,900	3,900	3,900	3,900	3,900
Three oilers	2,805	2,805	2,805	2,805	2,805
Electrician	1,300	1,300	1,300	1,300	1,300
Fireman	2,970	2,970	2,970	.....	.....
Maintenance	8,750	6,800	6,800	4,000	4,000
Oil, waste, ammonia, water, etc.	10,000	7,530	7,350	4,000	4,000
Total operating expense	59,725	43,791	41,725	63,505	59,755
Interest, 6 per cent	16,800	14,400	14,400	9,600	9,600
Depreciation, 3⅓ per cent	9,330	8,000	8,000	5,330	5,330
Insurance	280	240	240	160	160
Total plant expense	$86,135	$66,431	$64,365	$78,595	$74,845
Deduct rental for space released by use of electrically driven plant	.....	.....	.....	14,000	14,000
Total net plant expense	$86,135	$66.431	$64,365	$64,595	$60,845

*(1) Absorption machines; (2) steam-driven compressors with Corliss engines; (3) steam-driven compound compressors; (4) high-speed simple compressors driven by synchronous motors, and (5) high-speed compound compressors driven by synchronous motors.
†Coal at $3.15 per long ton and energy at 0.00825 per kilowatt-hour.

tons based on a brine temperature of — 15 deg. Fahr. (— 26 deg. C.) with a suction pressure of 3 lb. (0.2 kg.) gage and a condenser pressure of 155 lb. (11 kg.). Consideration was given to the following methods of installation: (1) absorption machines, (2) steam-driven compressors with Corliss engines, (3) steam-driven compound compressors, (4) high-speed simple compressors driven by synchronous motors, and (5) high-speed compound compressors driven by synchronous motors. The cost of equipment for each one of these methods of operation was

found to be $277,113, $238,728, $237,728, $158,165 and $157,165 respectively, making the motor-driven high-speed compound compression installation cheaper.

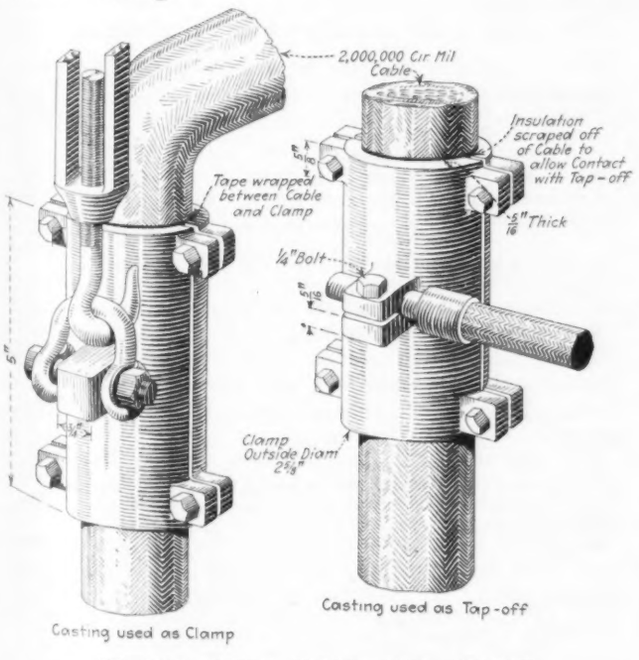
The operating expenses under the five methods of operation considered are about as shown in the accompanying table. Again the cost is less for motor-driven compound compressors.

As a result of these estimates four refrigerating machines were installed, each to be driven by a synchronous motor. The other electrical equipment consists of six 500-kw. transformers which change energy from 7830-volt, three-phase, 61½-cycle energy to 1950-volt, two-phase energy.

CABLE CLAMP AND TAP-OFF MADE FROM SAME CASTINGS

Because Bronze Piece Can Be Easily Adapted to Serve in Either Capacity Construction Work Can Be Hastened

The cable clamp and tap-off shown in the accompanying illustration were manufactured from castings made from the same pattern. The casting is sawed in two parts and four holes drilled in the side lugs so that the halves can be clamped around the cable. When the casting is to be used as a cable clamp a hole is drilled in the lugs at right angles to the cable axis. A bolt in this hole holds a "U"-bolt, which in turn holds a turnbuckle supported from the ceiling.


2,000,000 Cir. Mil Cable
Insulation scraped off of Cable to allow Contact with Tap-off
Tape wrapped between Cable and Clamp
5/16" Thick
1/4" Bolt
Clamp Outside Diam 2 5/8"
5"
Casting used as Clamp
Casting used as Tap-off

SPECIAL CABLE CLAMP AND TAP-OFF

When used as a tap-off a hole is drilled in the lug perpendicular to the cable axis to hold the lead terminal, but in addition the lug is sawed as shown. The bottom half of the hole drilled in the lug is threaded so that the ¼-in. (6-mm.) bolt can hold the lead conductor.

When a cable has to be held by one of these clamps it is taped so that the casting will not slip. When the casting is used as a tap-off, however, the cable insulation is removed so that a good contact will be obtained.

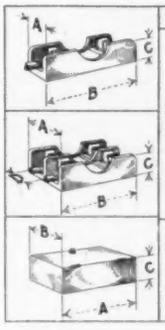
New York, N. Y. Charles E. Smith

TABULATED DATA ON CUT-OUT BOXES AND FUSE BLOCKS

Dimensions Which Facilitate the Determination of the Proper Type of Material to Order for a Certain Installation

So that the correct size of cut-out boxes and fuse blocks could be ordered without referring to catalogs, the writer has compiled the data shown herewith. These data can be pasted in a notebook and be always available for use.

As the ampere and voltage rating of the fuses are known, the dimensions *A*, *B* and *C* of the fuse block can be ob-



		DIMENSIONS OF BOXES FOR FUSE BLOCKS				
		AMP.	A	B	C	D
250 VOLTS	2 FUSES	30	6	6	3	
		60	9	6	3½	
		100	15	9	4	
		200	18	9	4½	4
		400	24	12	5	5
	3 FUSES	30	6	6	3	
		60	9	9	3½	
		100	15	9	4	
		200	18	16	4½	4
		400	24	18	5	5
600 VOLTS	3 FUSES	30	12	9	3½	
		60	15	12	4	
		100	18	16	4	5½
		200	20	16	5	4½
		400	28	21	5½	6

SIZE OF BLOCKS			
250 VOLTS			
AMP.	A	B	C
30	1½	3⅜	1½
60	2	5⅛	2
100	2¾	6⅜	2½
*200	2¾	12	3⅜
*400	2¾	14¼	3⅜
600 VOLTS			
AMP.	A	B	C
30	2	6½	2
60	2⅜	8¾	2¾
*100	2	10¼	2⅜
*200	2½	14½	3⅜
*400	3	17¾	3½

* SLATE BASE

250 VOLT N.E.C. CUTOUT BOXES			
MFGRS. NO.	A	B	C
	6	6	3
	6	6	3
	6	9	3
	6	12	3
	9	9	3
	6	12	3
	9	15	3
PLUG CUTOUTS			
	6	6	3
	6	6	3
	6	6	3
	6	6	3
	6	9	3
	9	9	3
	6	9	3
	9	12	3

DIMENSIONS ARE IN INCHES

CUT-OUT BOX AND FUSE-BLOCKS DATA

Dimensions of fuse blocks and cut-out boxes can be obtained from the table. Then the correct box can be ordered if the manufacturers' numbers are inserted correctly.

tained by reference to the table. Furthermore, the data contained in the table will indicate the size of the box needed to inclose the fuse blocks whether they number two or three or be for 250 volts or 600 volts service. Space for the manufacturers' numbers of boxes and blocks is provided in the table, but the numbers are not shown here.

John F. Hanley,
Formerly Chief Electrical Inspector Boston Army Supply Base, Lawrence Mass.

SEMI-REMOTE CONTROL FOR REFRIGERATING MACHINE

Contactor and Controller Circuits Are Interconnected to Avoid Closing Motor Primary Circuit When Rotor is Short-circuited

Complete control of the motors operating the refrigerating machines in the Seattle (Wash.) municipal cold-storage plant is obtained by the following arrangement of contactors in the motor circuits. The three 150-hp. Westinghouse motors which drive the three 110-ton ammonia compressors are controlled by what might be termed a semi-remote control, consisting of a magnetically operated contactor connected in series with the motor switches. The contactor is controlled through a push-button switch at the motor controller, which is placed near the machine. The controller and contactor control circuit are interconnected to avoid the closing of the primary circuit of the motor with a short-circuited rotor.

An automatic master relay is provided for each machine to prevent excessive ammonia pressure, which is so connected as to open the contactor when the pressure reaches a predetermined value. A number of auxiliary push buttons are also connected into this circuit.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Methods for Increasing the Use of Electric Light, Power and Heat

POLICY OF VOLUNTARY RATE REDUCTION ESTABLISHED

St. Louis Company Has Filed New Schedule Reducing Maximum Rate from 8½ Cents to 8 Cents

The Union Electric Light & Power Company, St. Louis, has voluntarily restored its pre-war residence schedule, with slight modification in the points at which the rates change. This means a reduction of about one-half cent per kilowatt-hour. It would also cause a drop in revenue of about $75,000 per annum were it not for the fact that increased use is expected as a result of the lower rates.

Other changes which will theoretically mean a reduction of $100,000 a year in revenue were made on power schedules. These included a modification in the definition of light and power which permits lighting up to 20 per cent of the total load to be used on increment power rates.

The company believes that the peak of war prices has been reached and that the trend of operating expenses is no longer upward. Plenty of reserve generating capacity is available, and it is hoped that the rates can be held down to the new levels by increasing the density of customers and getting more diversified and longer hours' use of service.

GROWTH OF CENTRAL-STATION SERVICE IN NEW YORK CITY—I

Results of Tests in Representative Buildings to Determine Relative Merits of Central and Isolated-Plant Supply

BY W. H. WHITTON
New York Edison Company

During the past two or three years one of the notable developments in electrical production has been the great increase in the use of central-station service and a corresponding reduction in the output of isolated plants, many of the latter having been shut down, some permanently and others either as a war measure or experimentally, to determine by test the relative merits of the two systems.

In the last-mentioned category are a number in the New York territory where arrangements were made with the proprietors, when central-station service was substituted, that careful cost records should be kept during the first year following the change and comparative data then prepared. Several representative buildings have completed this test period, and as the results possess undoubted value to those confronted with similar questions, they are here presented.

The comparison is based on one year with the plant and one year with central-station service. As a logical presentation of the matter requires that the comparative operating costs be placed on an equal basis, the same scale of prices has been used in determining both plant and Edison costs. Prices to-day are far advanced over what they were during the period that the plants were in operation, making a direct comparison practically valueless.

Case I.—Case I is a modern printing and manufacturing building in the lower part of New York, perhaps the best representative of its class in the city. It is sixteen stories high, has a content of about 4,000,000 cu. ft. and is equipped with about 2500 incandescent lamps and 800 hp., this including seven elevator motors. The plant consisted of two 300-kw. and one 100-kw. generator directly connected to Corliss engines, two balancer sets being used to adapt the 240-volt service to the three-wire lighting system. The boiler plant comprises four 300-hp. water-tube units, using natural draft, and all auxiliaries, with the exception of boiler-feed and oil pumps, are motor-driven.

With the generator engines shut down, live steam is still required for the feed pumps and for industrial purposes, the latter supplied through a 2-in. pipe. It is estimated that 400 tons of coal per year are chargeable to this industrial steam.

Following is the comparative study of the operating casts:

Cost with plant:	
Coal, 7037 tons	$52,426
Labor, eleven men	13,104
Ash removal, 29,200 cans	3,971
Boiler water (additional)	400
Supplies (additional)	800
Repairs (additional)	2,000
	$72,701
Cost with Edison service:	
Coal, 2307 tons	$17,187
Labor, five men twelve months and five men six mo.	10,352
Ash removal, 9000 cans	1,224
	$28,763
Edison service	38,166
Total	$66,929
Saving:	
Coal, 4730 tons	$35,239
Labor, one man twelve months and five men six mo.	2,752
Ash removal, 20,200 cans	2,747
Boiler water	400
Supplies	2,000
	$43,938
Edison service	*38,166
Total	$5,772

The saving in favor of central-station service of $5,772 is substantial, but it will be further increased next year if certain changes now in contemplation are made. The use of energy owing to the increased manufacturing requirements was about 10 per cent greater than in the previous year. It will be noted that the fuel saving amounted to about 67 per cent.

Case II.—Case II is a 400-room hotel of twelve stories, containing 2,365,000 cu. ft. It faces on two streets and receives fairly good natural light, and its in-

* Added cost of Edison service, deducted from savings to get net savings.

stallation amounts to 4000 lamps and 160 hp., including motors for four electric elevators.

The plant consists of four direct-connected generator units—one of 150 kw., one of 100 kw. and two of 75 kw. Steam is generated in three B. & W. water-tube boilers rated at 250 hp. each, and live steam is supplied to two brine pumps, a refrigerating plant, the hotel kitchen, and for heating three private houses, two garages and the hotel itself.

The comparative costs are as follows:

Cost with plant:	
Coal, 5400 tons	$31,110
Ash removal	2,480
Supplies	6,400
Labor, twelve men	16,478
Water	4,946
	$61,414
Cost with Edison service:	
Coal, 3380 tons	$19,473
Ash removal	1,563
Supplies	5,323
Labor, ten men	14,294
Water	4,743
	$45,396
Edison service	11,937
Total	$57,333
Saving:	
Coal, 2010 tons	$11,637
Ash removal	917
Supplies	1,077
Labor, two men	2,184
Water	203
	$16,018
Edison service	*11,937
Total	$4,081

The coal saving is about 46 per cent, which is considerably less than Case I, the greater steam requirements characteristic of hotel service causing the difference. No repair item is included, none having been recorded, but it is obvious that over a longer period repairs to the engines and generators would average a substantial sum. The saving with central-station service is accordingly even greater than shown.

Case III.—Case III is a downtown office building, fifteen stories in height, containing 1,671,000 cu. ft. The building receives natural light on two sides only and has an installation of about 2000 lamps and 245 hp. The plant consisted of three 100-kw. generators directly connected to simple slide-valve engines. A storage battery was used for voltage regulation and to supply the night load as well as that on Sunday and holidays.

Steam is generated in three water-tube boilers and, in addition to the building heating, is still used at high pressure for one boiler-feed pump, two vacuum pumps, two house pumps and for cooking purposes in a restaurant, the latter being supplied by two 1-in. pipe lines. There are seven Sprague screw electric elevators in the building, a type seldom encountered in this city.

The comparative figures are as follows:

Cost with plant:	
Coal, 3694 tons	$27,705
Labor, eight men	10,414
Water	1,375
Ash removal	1,811
Supplies	750
Repairs	3,100
	$45,155
Cost with Edison service:	
Coal, 1097 tons	$8,228
Labor, six men	8,353
Water	748
Ash removal	692
Supplies	203
	$18,224
Edison service	11,300
Total	$29,524
Saving:	
Coal, 2597 tons	$19,477
Labor, two men	2,061
Water	627
Ash removal	1,119
Supplies	547
Repairs	3,100
	$26,931
Edison service	*11,300
Total	$15,631

* Added cost of Edison service, deducted from savings to get net savings.

The consumption of energy last year amounted to 293,350 kw.-hr. The fuel saving is unusually great, 70 per cent, probably accounted for by the age and inefficiency of the plant equipment. It is the more noteworthy in view of the continued all-year use of high-pressure steam.

Owing to the expense of motorizing the pumping equipment and of changing the boilers to low pressure, it has been recommended that as an alternative measure a portion of the grate surface of one of the large boilers be bricked off, thus reducing its capacity to supply steam during the summer. Should either of these plans be adopted, there will be a still further saving of coal.

MAKING THE OPERATING DEPARTMENT PRODUCTIVE

By Combining Meter and Engineering Organizations Service Is Improved and Public Relations Are Bettered

In a medium-sized public utility departmental combinations often may be effected with great benefit to the service, according to a paper presented at the New London (Conn.) convention of the New England Section of the N. E. L. A. by Frank W. Randall of the Rockingham County Light & Power Company, Portsmouth, N. H. In this company the work of the meter and engineering departments is combined under the supervision of an engineer, and the results have shown advantageously in public relations, increased revenue and administrative economies.

The assignment of definite tasks to the men has created a feeling of responsibility and a pride in accomplishment which means better service to customers. Extensive operating records, connected load data, card indices of distribution system equipment, maps and other information maintained at headquarters have proved of great value. Such data make possible the detection of poor operating conditions and thus, by correction, lead to improved service. Complete records are also of great usefulness in connection with reports to the accounting department of the Public Service Commission.

On this system, Mr. Randall pointed out, the frequent checking of connected loads of demand schedule customers has been a source of increased revenue to the company. The delivery of bills in the central business districts has saved more than $180 per year over the mailing method. The use of the post card for delayed meter readings has

effected a considerable saving in meter reading time. Over 85 per cent of the cards left are returned properly marked. The combination of departments effects a saving in the expense of operation owing to the fact that the data for both departments can be collected by the employees in connection with their routine work, and in this work a favorable attitude on the part of the public is assured through the efforts of all employees to render maximum service.

The record systems used at Portsmouth include many common arrangements of card indices and some which are out of the ordinary. Cards are standardized in the 4-in. by 6-in. size, and the connected load cards are subdivided into motor load, showing all motors connected, heating load, giving the data of all ranges, heaters, etc., and lamp load, showing the number of lamps of the various sizes with the total wattage for each customer on the demand schedule.

Employees are carefully trained in commercial policies, and departmental meetings show excellent results in stimulating and maintaining interest in the broader usefulness of the utility.

ELECTRIC HOUSE HEATING NOT FEASIBLE IN IDAHO

Idaho Commission Declares that the First Economic Use of Energy Is for Motive Power and House Heating Would Be Wasteful

Under the rates published by some of the power companies (from 3 to 4 cents per kilowatt-hour for cooking and household appliances and a flat rate of $3 per month per killowatt-hour of installed capacity for domestic water heating) a great many people in Idaho have found it feasible and practicable to use electrical energy for cooking and in household appliances and for domestic water heating in competition with coal.

After long investigation the Idaho Public Utilities Commission has reported its conclusions on the subject of electric open-air house heating. It finds "no grounds for holding out to the people of Idaho a reasonable hope that electricity will ever be used generally for house heating in our state, and we are forced to the conclusion that the use of electric energy for house heating in Idaho in competition with coal is neither feasible nor practicable and would be unprofitable to any producers who might undertake to furnish the service, and further, that so long as there remains a field for the use of electric energy as motive power, its use for house heating is extravagant and wasteful."

The investigation was undertaken by the commission on its own motion. All electric utilities in the state were notified to appear. At various times articles had appeared in the press calling attention to the abundant water power in Idaho which was being allowed to waste and suggesting that it should be harnessed for heating the homes of all. The question was injected into political campaigns. The further fact that electrical energy is being furnished for heating purposes to a limited number of dwellings in the Twin Falls district of the Idaho Power Company and to numerous homes and business houses within the territory covered by the Minidoka project of the United States Reclamation Service suggested the inquiry made by the commission.

In the discussion of the case it was assumed that the electrical energy is generated by water power, as electric development in Idaho is based almost exclusively on that source of power. Two difficulties were presented: (1) the enormous amount of electrical energy required for heat service; (2) the cost of energy for that service as compared with cost of coal, the present fuel in southern Idaho.

Dr. Joseph S. Merrill, director of mines and engineering and professor of physics and electrical engineering of the University of Utah, was one of the witnesses and references to his testimony are made in several places in the decision of the commission. Dr. Merrill estimated that it would take all the water power feasible to be developed in Idaho to furnish electric heat to about 77,000 homes, which is a less number than the present homes in the state.

Assuming that there must be a large additional installation to serve a heat load, the commission found that all the evidence in the case was to the effect that electric house heating would cost from six to nine times as much as coal in southern Idaho.

There remains one other source of supply of electrical energy that may compete with coal for heating purposes, namely, the energy used for irrigation pumping, for which there is no market in winter. This is the supply that makes possible the electric heating of houses on the Minidoka government reclamation project.

Barry Dibble, project manager for the government, submitted a report at the request of the commission in which he said:

"It should be emphasized that the data that are given apply only to the peculiar conditions prevailing on the Minidoka project and cannot be safely applied to other power systems. It can be said that electric heating is sometimes justified as a 'by-product' load, but that rarely if ever will it be economically feasible to develop electricity from water power for the prime purpose of using it generally to heat buildings where fuel can be obtained at reasonable prices."

Subsequent to the hearing in this case the wholesale rates for electric heating heretofore charged by the government on the Minidoka project had been increased by at least 50 per cent, to take effect in March, 1920. This does not mean that electric heating on the Minidoka project will be discontinued, but the cost to the consumer will probably be around $1.75 per kilowatt per month, which, based upon the commission's estimates of the installation needed to heat a six-room house comfortably, will exceed the cost of coal for an equivalent amount of heat.

Looking at the subject from the larger viewpoint of conservation, the commission said:

"In the light of possible application of electric energy to mechanical uses in southern Idaho and the consequent saving of coal, it is at least premature to discuss electric heating of houses as a means of conserving our coal supply. It is shown in the testimony in this case that the heating by electricity of 15,000 homes in the territory of the Idaho Power Company would save approximately 100,000 tons of coal annually, and that a considerably smaller amount of electric energy than would be required to heat those homes would be sufficient to electrify the entire system of the Oregon Short Line Railroad in southern Idaho, with a resulting saving of approximately 1,000,000 tons of coal

annually, or a conservation of coal through the mechanical use of electricity as compared with its use for heating in the ratio of ten to one."

Dr. H. V. Carpenter, professor of electric engineering of Washington State College, testified that the actual conservation ratio as shown by the electrification of the Chicago, Milwaukee & St. Paul Railroad is about fourteen to one. "We believe," the commission said, "that the electrification of the Oregon Short Line Railroad is bound to be an accomplished fact in the near future, and that the use of any available electric current for house heating at this time, except as a seasonable by-product, would be extravagant and wasteful."

Dr. Merrill, in his testimony, suggested that the feasibility of using electricity for house heating in competition with coal be not confused with the possibilities of using electric heat in ranges and household appliances in competition with coal.

FORM OF CONTRACT FOR ELECTRIC RAILWAY POWER

Committee of American Electric Railway Engineering Association Working on Standard Form for Purchase of Energy

Forms of power contracts for the purchase of railway power are discussed in the report of the committee on power generation of the American Electric Railway Engineering Association presented at a recent convention in Atlantic City. The committee first tried to set up a standard form of power contract for the purchase of railway power. However, as operating conditions of the member companies are so diversified, it seemed impossible with the knowledge at hand to frame clauses applicable for large as well as for small power contracts except for specific cases.

Therefore the committee studied twenty existing contracts, details of which, excepting names of the companies, are given in the report. It was recommended that the subject be reassigned to the committee for the ensuing year with the suggestion that additional power contracts be analyzed and, if possible, a suggested form of contract be prepared. An index for such a form was suggested by the committee, as follows:

Article I—General Conditions.—(A) Duration of contract; (B) characteristics of power supply; (C) regulation (frequency and voltage).

Article II—Measurement of Energy.—(A) Point of delivery; (B) location of meter; (C) readings; (D) access to premises.

Article III—Meter Calibration.—(A) Periodical calibration; (B) accuracy of instruments; (C) adjustment in case of inaccuracy; (D) special calibration; (E) expense of special calibration.

Article IV—Demand.—Section 1: (A) Method of determining demand; (B) demand limits. Section 2: (A) Modification of demand, (1) minor, (2) major, (3) period of notice, (4) time for complying.

Article V—Automatic Extension of Duration of Contract.—(A) Increase of demand.

Article VI—Reserve Equipment.—(A) Generation; (B) transmission; (C) conversion.

Article VII—Rates.—Section 1: (A) Demand charge; (B) energy charge; (C) minimum charge; (D) emergency demands. Section 2: (A) Deductions; (B) failure of supply, (1) partial, (2) complete. Section 3: (A) Rate changes, (1) investment, (2) fuel, (3) labor; (B) other sources of supply; (C) rates to other customers; (D) changes in the art; (E) laws and ordinances.

Article VIII—Payments.—(A) Billing; (B) payments.

Article IX—Cancellation.—(A) Failure to supply; (B) other reasons.

Article X—Arbitration.

Article XI—Assignment.

DEVELOPING PROFITABLE LOADS OFF THE PEAK

Electric Vehicles and Furnaces, Ice Making, Electrochemistry and Summer Service to Isolated Plants Are All Rich Fields

In discussing off-peak loads that can be profitably served by the central station before the Illinois State Electric Association convention in Chicago, George H. Jones, Chicago, said:

"The electric vehicle is the most profitable load in this class as it is off the daily peak and off the annual peak. A single customer pays to the Commonwealth Edison Company $2,000 a month for charging. Ice making, another proved line, is only six or seven years old, but in some cities requires 50,000,000 kw.-hr. a year.

"Regarding electric furnaces, another source of profit, we should not be discouraged by some slump from the high artificial level of the war in the rate of installing new furnaces. Electrochemical processes are still another good class of off-peak power. The Power Sales Bureau of the National Electric Light Association is studying this business and will classify the loads that can be served profitably.

"Supplying isolated plants during the summer when the exhaust steam is not needed for heating is a source of profit, besides being a service to the public in conserving probably 6½ lb. of the 9 lb. of coal used by the isolated plants per kilowatt-hour."

POLICY ON PREMIUMS AND TRADING COUPONS

Why Commonwealth Edison Company Gives Premiums with Washing-Machine Sales and Trading Coupons with All Sales

When the Commonwealth Edison Company went into the merchandising business its first problems were its advertising and selling policies. At first it used the newspapers, billboards, street-car advertising and direct-by-mail advertising. Even though all these methods of stimulating business were tried, it was found that thousands of people who were buying energy from the company were not coming into its stores. The company had about 325,000 residential customers and it was reaching only a small percentage of them in its merchandising efforts. It was then decided to try the coupon plan of getting the people to come into the stores. This is bringing a much larger percentage of the company's customers.

At present the company is offering to give with each washing machine sold either a number of Federal profit-sharing coupons, which can be redeemed in electrical merchandise, or a standard floor lamp. If the coupons are redeemed by the purchaser of washing machines, experience has shown that he usually chooses four high-wattage devices, and these, going with the washing-machine sale, will increase the energy consumption from that particular customer fivefold or sixfold.

DIGEST OF ELECTRICAL LITERATURE

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Heating of Transformers.—A. ZELEWSKI.—The author criticises certain of the premises and results in a paper by Vidmar on this subject. The question of the initial current rush is important both from the theoretical standpoint and from the point of view of the provision which must be made to keep the current within safe limits. The author considers that Vidmar bases his results to some extent upon questionable theory and the attaching of too great importance to certain phenomena. By making various approximations, which err on the side of safety, the author reaches the conclusion that the initial current rush is less severe than the short-circuit current. Reference must be made to the original for the mathematical analysis of the problem. The transformers used as examples are: (a) A 50-kva. transformer with 6 per cent and an ohmic voltage drop of 1½ per cent; (b) a 1500-kva. transformer with 10 per cent and 0.8 per cent inductive and ohmic voltage drops respectively; (c) a 1600-kva. transformer with 14.5 per cent inductive and 0.5 per cent ohmic voltage drop.—*Science Abstracts, Section B,* Sept. 30, 1919. (Abstracted from *Elektrot. u. Maschinenbau,* Sept. 30, 1919.)

Generation, Transmission and Distribution

An Extension of the Step-by-Step Method of Transmission-Line Computation.—FREDERICK EUGENE PERNOT.—The author derives the equations which are exact solutions for transmission lines, with the constants assumed to be concentrated at various positions in the lines. These are therefore only approximate solutions for lines of purely distributed constants. The results, however, check very well with the exact hyperbolic solutions.—*University of California Publications,* July 10, 1919.

Calabogie Hydroelectric Development.—A. L. MUDGE and A. R. WHITELAW.—This plant is located on the Madawaska River in the Province of Ontario, Canada. Power was available seven months after the starting of the work. This record in construction was made possible owing to war emergency and to the fact that the machinery was diverted from other projects. The plant is, briefly, a 6000-hp. development under 27-ft. (8.2-m.) head. Details of the rapid construction work are given in the article.—Toronto *Electrical News,* Oct. 1, 1919.

Tidal Power and Coal Conservation.—WILLIAM T. TAYLOR.—It is pointed out that with the rising cost of coal and the improvement in low-head hydroelectric machinery the problem of utilizing the power of the tides should receive more attention.—*Electrical Times,* Oct. 2 and 9, 1919.

Comparative Economy of Water and Steam Power.—W. STRAUS.—The author considers that the results of the war have altered the conditions under which it will be profitable to use water power. It seems very likely that the price of coal will fall; the cost of building materials will remain high, and there seem many reasons to think that the position of the hydroelectric station will be improved. The author also defends the exploitation of water power on the ground that, directly and indirectly, it will tend to absorb a large volume of unemployed labor. The main body of the paper is concerned with the question of finance, and a number of curves are given showing the annual cost of water and steam power with different load factors. The author thinks there may be a future for power stations in which coal-tar by-products can be manufactured, in case the prices for these by-products remain at their present levels.—*Science Abstracts, Section B,* July 31, 1919. (Abstracted from *Elektrot. Zeits.,* May 1, 1919.)

The Standardization of Voltages in Switzerland.—This is a further attempt by the secretary of the Swiss Institution of Electrical Engineers to inaugurate a general discussion of the question of the possible standardization of voltages for three-phase current. The present paper deals with the outlines of the problem.—*Science Abstracts, Section B,* July 31, 1919. (Abstracted from *Schweiz. Electrot. Verein.,* April, 1919.)

Water Power on the Italian Riviera.—CLAUDE H. C. WOODHOUSE.—A brief description, well illustrated, of water-power projects in Italy with heads ranging from 195 ft. to 2600 ft. (60 m. to 800 m.) and plant capacities of from 6000 kw. to 56,000 hp.—London *Electrical Times,* September 18, 1919.

Swiss State Railways Electricity Works, Massaboden.—In order to insure satisfactory train service an arrangement was made with the Milan station for the supply of extra energy for the south end, and for the north end the following project was accepted: To build a new central station at Massaboden and to construct a storage reservoir. The original Morel-Brig water-power plant comprised the dam near Morel, a reinforced concrete canal 3.2 km. long, carrying a volume of 6 cu. m. per second, the water tower at Bitch, a pressure main 1.5 km. long and the temporary power station near the entrance to the tunnel. The new project made use of the old dam and of the canal, and in addition a storage reservoir has been built with a storage capacity of 8000 cu. m., into which other water supplies have been brought. The long old pipe line has been superseded by one only 80 m. long, and the new power station is built close to the confluence of the river Massa with the Rhone. In order to serve for the double tunnel the station will contain generating sets which will develop: (1) Alternating current at 50 cycles for the lighting of the station and tunnel, an average of 80 kw. and a maximum of 120 kw.; (2) polyphase current at 16 cycles for the tunnel ventilation and working of the entrance screen, an average of 250 kw. and a maximum of 380 kw.; and also, for the working of the trains over the whole Brig-Iselle section, an average of 520 kw.

and a maximum of 3500 kw., making a total of 850 kw. average and 4000 kw. maximum.—*Technical Review*, Sept. 2, 1919. (Abstracted from *Schweizer. Bauzeitung*, June 14, 1919.)

Sources of Power for California Railroad Electrification.—F. H. Fowler and Robert Sibley.—A summary of the conditions in California showing what power development is necessary for the electrification of the steam railways of the state and also the available potential power of the mountain streams.—*Journal of Electricity*, Oct. 15, 1919.

Installations, Systems and Appliances

Searchlight Electrodes.—W. H. Hardman.—It is said that at the time of our entrance into the war, although the United States manufactured nearly ten times the total output of electrodes from the European factories, the quality of those made in this country was low compared to those formerly imported. An idea of the chief requirements in the production of a good electrode may be obtained from the specifications for the high-intensity positive electrode for the 36-in. (91-cm.) and 50-in. (152-cm.) drum-type projectors, given below. This electrode is 1100 mm. long and 16 mm. in diameter with an 8-mm. core of flaming salts. The shell and core are extruded separately. The one-piece core is inserted in the shell with a minimum clearance and firmly cemented. It must be substantially straight, any curvature must be evenly distributed along the entire length, and the maximum curvature must not exceed 2 mm. It is said that good calcined lampblack or other finely divided carbon lends itself well to the manufacture of high-grade electrodes. The carbon powder is mixed with some bonding material and formed into pellets which are put into the steam cylinder of the extrusion press and squirted out through a die of the desired size. After the baking or firing the electrodes are carefully cored. After the coring material has been uniformly packed into the center of the carbon, tests are made to determine the electrical resistance, the tensile strength, density and hardness. As a result of such work electrodes were made for operation at current densities of 150 amp. to 500 amp.—*General Electric Review*, September, 1919.

Electric Welding, Its Theory, Practice and Application.—H. S. Marquand.—In this number of the series the author discusses the characteristics of long and short metal arcs and the proper fusing of the deposits. A table is offered showing the chemical analysis of the metal deposited in welds after passing through the arc for various types of electrodes.—London *Electrician*, Sept. 19, 1919.

A New Method of Locating Cable Faults.—E. Wurmbach.—A simple method of locating faults in armored cables is here described. If the core is connected to one pole of a direct-current pressure supply whose other pole is earthed, a current will pass along the core entering the armoring at the fault. By means of a needle galvanometer connected to the armoring the position of the fault may be determined, since when the positive pole is earthed the negative pole of the instrument points toward the fault. A clamp specially adapted to make good contact with the armoring is described. The method is applicable to the case of alternating-current systems without an earthed neutral if one phase is earthed, to direct-current two-conductor systems and to direct-current three-core cables when the middle core is earthed; and it has this advantage, there is no need to cut the cable and it is necessary to uncover the cable at a few points only.—*Science Abstracts, Section B*, July 31, 1919. (Abstracted from *Elektot. Zeits.*, May 8, 1919.)

Production of Silicon Manganese in Electric Furnaces.—B. G. Klugh.—Some data obtained in actual practice producing alloys of silicon and manganese in electric furnaces are presented. The author also discusses possible uses of silicon manganese in this country and abroad.—*Proceedings A. E. S.*, April 4, 1919.

Electric Furnace Operation in United Kingdom.—R. G. Mercer.—It is said that there are installed or being installed in the United Kingdom 141 electric furnaces, with a total capacity of 112,000 kva. Of these 117 are electric steel furnaces having a total charging and kva. capacity of 384 tons and 98,769 kva. A summary of these furnaces is given with the table attached.—Toronto *Electrical News*, Sept. 15, 1919.

ELECTRIC STEEL FURNACES IN THE UNITED KINGDOM

Make	Number of Furnaces	Total Tons, Size.	Total Kva.	Nominal Tons Output per Month.
Electrometals...	27	73	20,274	6,740
Greaves-Etchells	26	64½	18,830	5,680
Heroult	45	180½	43,220	13,560
Rennerfelt	4	7	1,895	750
Snyder	6	9½	3,150	1,200
Special	2	2	750	280
Stassano	2	2	600	240
Stobie	5	45½	10,050	2,600
Totals	117	384	98,769	31,250

Electric Brass Melting, Its Progress and Present Importance.—H. M. St. John.—The writer sums up the advantages of the electric furnace as follows: (1) Metal saving, (2) improved quality, (3) exact temperature control, (4) increased production, (5) elimination of crucible cost, (6) incidental savings, (7) better working conditions. He finds that there are five types of electric furnaces in commercial use for melting copper alloys. Of these the direct-arc and the stationary indirect-arc furnaces are really steel melting furnaces temporarily adapted for brass-melting purposes. The induction furnace is highly efficient but seriously limited in its application. For continuous operation on yellow brass of constant composition its small size is the only weighty disadvantage. The rocking indirect-arc furnace is nearly if not quite as efficient as the induction furnace, can be built in much larger sizes and shows a performance throughout the field of copper-alloy melting quite as favorable as that of the induction furnace in its more circumscribed province. It is equally suitable for intermittent or continuous operation and will handle any desired variety of alloys. The indirect-resistance furnace is much more flexible in its use than the induction furnace, somewhat less flexible than the rocking indirect-arc furnace and far less efficient than either. Its low efficiency and slowness of melting are its principal handicaps. It is estimated on reliable authority, the author states, that about 1 per cent of the brass melting in the United States is now done electrically and that approximately 90 per cent could profitably be done in this manner.—*Electric Journal*, September, 1919.

Phenomena of Oil Circuit Breakers and Regulative Possibilities.—P. Charpentier.—A study of the phenomena of alternating-current interruption in oil and of the research necessary to the establishment of a uniform series of circuit breakers. The subject is treated under

these headings: "Previous Experiments," "Interruption in Oil—Creation and Rupture of Arcs," "Rupture and Re-formation of Arcs," "Calorific Phenomena of the Arc—Their Influence Upon Its Rupture," "The Form of Gaseous Envelopes," "Influence of Multiple Rupture," "Calorific Effects of the Arc—The Work of Rupture," "Interruptible Power," "Experiments in the Interruption of High Powers in Short Circuit," "Determination of Apparatus," "Necessity for Systematic Experiments," "Series Construction." The author concludes that either systematic experiments at a central point should be made before adopting rules for the government of oil circuit breakers, or else arbitrary formulas should be adopted with fixed constants based on all the information available on existing apparatus which has given satisfaction or has been subjected to known experiments.—*Revue Générale de l'Electricité,* Sept. 27, 1919.

Electrophysics and Magnetism

Location of Flaws in Rifle-Barrel Steel by Magnetic Analysis.—R. L. SANFORD and M. B. KOUWENHOVEN.—This paper describes an investigation which was undertaken for the purpose of determining whether an application of magnetic analysis was practicable for the detection of flaws in rifle-barrel steel. By means of apparatus especially constructed for the purpose, a large number of bars were explored for magnetic uniformity along their length. The results demonstrated that the method is amply sensitive for the selection and locating of flaws. Further study is necessary to determine to what degree the sensitivity should be reduced in order not to cause the rejection of material which is satisfactory for all practical purposes and also to determine the type and magnitude of the effect which will be produced by a pipe. The investigation is being continued by the Winchester Repeating Arms Company.—*U. S. Bureau of Standards, Scientific Paper No.* 343, Oct. 3, 1919.

Electrochemistry and Batteries

Depreciation in Small Dry Cells with Age.—A. J. HELFRECHT.—The author shows how closely the method of judging cell deterioration called "flash test" approaches actual measurements of capacity through discharging the cells. Comparative curves for the different sizes of cells tested are given. From the data gained by this investigation estimates have been compiled indicating reasonable depreciation of the four sizes of small cells. These are indicated in the following table:

Size of Cells		Per Cent Depreciation per Month	
Inches	Centimeters	First Two Months	Last Ten Months
2¼x1¼	5.7x3.2	0.0	2.1
1 13-16x⅞	4.6x2.2	0.25	4.0
1⅞x⅝	4.8x1.6	2.0	5.5
1 9-16x17-32	4.0x1.4	2.0	6.5

—*Proceedings American Electrochemical Society,* Sept. 23, 1919.

Units, Instruments and Measurements

Computation of Precision Photometer Scales.—GORDON THOMPSON.—This paper gives a simple method of accurately computing distances for all the graduations of a photometer scale. The method is explained in considerable detail in order to facilitate its application in similar computations.—*Transactions I. E. S.,* Aug. 30, 1919.

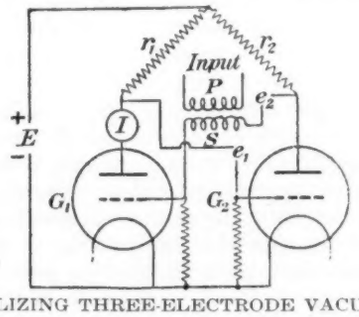
The Accuracy of Measuring Instruments.—A. BARBAGELATA.—The Italian Electrotechnical Committee is preparing regulations for measuring instruments. In the present article the author expresses his ideas on the subject. He sets forth to specify the accuracy of a measuring instrument by giving the percentage errors at the maximum reading and at a certain fraction, say one-tenth, of the full scale, so that the accuracy of an instrument could be conveniently indicated, for instance by 0.3 (1/10 — 1.2 per cent, which would mean that at one-tenth of the full scale the error would be larger than 1.2 per cent of the full, scale reading and at full deflection not larger than 1.2 per cent of the same reading. Among the three types of scales, namely, uniform, contracted at the beginning and contracted at the end, the author demonstrates that the preference should be given to the third one.—*Science Abstracts, Section B,* Sept. 30, 1919. (Abstracted from *Elettrotecnica,* June 25, 1919.)

Method of Measuring the Capacity of Gold-Leaf Electroscopes.—A. T. MUKERJEE.—An arrangement for using a Dolesalek electrometer has made it possible to develop a quick and accurate method of measuring extremely small capacities such as those of gold-leaf electroscopes. Using a standardized sliding condenser, the absolute value of the capacity of the quadrant system, including a specially designed connector, is first determined by the method of mixtures. The gold-leaf system of the electroscope is then charged to a known voltage, adjusted so that when the charge is shared with the quadrant system the final potential as measured by the electrometer is not far from 1 volt. As the capacity of the quadrant system can be varied by the sliding condenser, the capacity of the electroscope can be measured at different voltages. There is a small but definite increase of capacity with the voltage.—*Philosophical Magazine,* August, 1919.

Use of Thermionic Lamps in Measuring Alternating Currents.—H. ABRAHAM, E. BLOCH and L. BLOCH.—In this study, published in the *Comptes Rendus* of the French Academy of Sciences, the authors describe apparatus of extraordinary sensitiveness designed by them to measure by the use of amplifying lamps very feeble currents and also wave lengths.—*Revue Générale de l'Electricité,* Aug. 23, 1919.

Telegraphy, Telephony and Signals

A Trigger Relay Utilizing Three Electrode Thermionic Vacuum Tubes.—W. H. EGGLES and F. W. JORDAN.—By a well-known method a triode tube for amplification of wireless signals and inductive coil is placed in the fila-



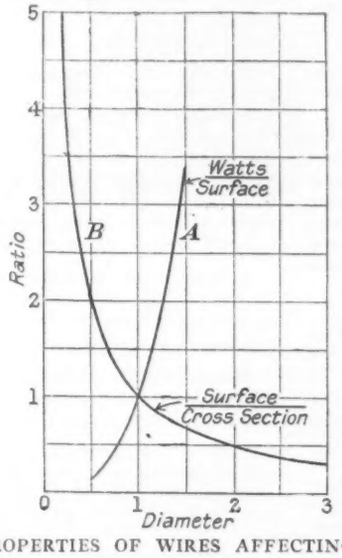
RELAY UTILIZING THREE-ELECTRODE VACUUM TUBES

ment-to-anode circuit, and another coil magnetically coupled with this is introduced into the filament-to-grid circuit. One method of using resistance to accomplish the same purpose is shown in the illustration where two tubes are interconnected. The stimulus from outside

which it is desired to detect and amplify is introduced to the grid of the first tube through a transformer and an indicating instrument is connected as shown. The following are typical numerical values for the circuit: $E = 80$ volts, $r = r_2 = 100{,}000$ ohms, $e = e_2 = 40$ volts.—London *Electrician,* Sept. 19, 1919.

Application of Amplifiers to Printing Telegraphy.—H. Abraham and Eugene Bloch.—This contribution to the *Comptes Rendus* of the French Academy of Science deals with the employment of amplifiers to enable the wireless-telegraphic signals to be inscribed upon bands of smoked paper or Morse bands without any mechanical relays. The methods were worked out for the military radio-telegraphic service.—*Revue Générale de l'Electricité,* Sept. 13, 1919.

Thermophones or Hot-Wire Receivers.—Thermophones are actuated by heat instead of electromagnetism, and hence their characteristics are different from those of the usual electromagnetic receivers. Speech is reproduced in the receiver by the motion of columns of air adjacent to the small heated wires. In this case the diameter of the wire is of great importance, and it is well to consider the relationship between the watts in the wire and the diameter of the wire. For a given current density it may be seen from the diagram that the ratio of watts to surface area falls off very rapidly for small diameters of conductor, and it is also evident that the ratio of surface to cross-section becomes lower as the diameter increases. It is readily understood that with very thin wires the great area of radiating surface as compared with the small cross-section allows the heat generated by the current to dissipate very rapidly. This property is made use of in the construction of thermophone receivers. The hot-wire receiver will only respond to the transmitter to which it is connected. When speaking it is necessary to speak close to and into the transmitter mouthpiece for the best transmission. Inductive effects are absent and, there being no diaphragm, there is no inherent distortion. The instrument has the great advantage of responding perfectly to low-spoken tones or whispers, and if the voice is raised there is no clash or confusion of sounds. It is extremely light in weight, from 0.25 oz. (7 g.) to 0.5 oz. (14 g.) according to the model.—London *Electrician,* Sept. 5, 1919.



PHYSICAL PROPERTIES OF WIRES AFFECTING DESIGN OF THERMOPHONE

Airplane Antenna Constants.—J. M. Cork.—The scope of the work contained in this paper is the collection of information regarding the effective capacity, effective resistance, true capacity, true inductance and wave lengths, as well as transmitting directional effect, of various types of airplane antennas. In addition to trailing antennas of one, two and four wires, the constants of various fixed antennas were measured in an attempt to find a satisfactory substitute for the trailing wire at short wave lengths.—*Scientific Paper No. 341, U. S. Bureau of Standards,* Sept. 17, 1919.

New Wireless Service on the Island of Borneo.—Jacques-Boyer.—The writer describes the installation of a wireless station for communication between Kuching, a commercial town of 40,000 people, situated on the island of Borneo, and Singapore.—*Wireless World,* August, 1919.

Simultaneous Sending and Receiving.—Ernst F. W. Alexanderson.—A system of simultaneous reception and transmission for radio-telephony is described together with the reasons for its use. It involves transferring the received speech (from a separate receiving antenna at some distance from the transmitting antenna) to the subscriber's line and transferring speech originating at the subscriber's station to the radiophone transmitter. Another type of duplex radio communication is considered, this being based on nearby receiving and transmitting antennas so arranged with their associated apparatus that the receiver and transmitter are in conjugate branches of a Wheatstone bridge. The wiring of the bridge receiver is given and the apparatus shown. A so-called "barrage receiver" is than described. This is a highly directional combination of aperiodic antennas, with unilateral directional characteristic. When two aperiodic antennas are used the phase difference of the received currents produced in them depends on the direction of the incoming signals. By phase-shifting devices and differential coupling to a common receiver, the signals from any given direction can be balanced out. The wiring and apparatus and the functioning are described.—*Proceedings Institute of Radio Engineers,* August, 1919.

Miscellaneous

A Relation Connecting the Derivatives of Physical Quantities.—M. D. Hersey.—In this paper it is shown how the theory of dimensions may be used in a differential form—a procedure which appears fruitful particularly in investigating the effect of given sources of error on the performance of measuring instruments. The examples which led to the necessity for developing this method are discussed at the end of the paper and illustrated by experimental data.—*United States Bureau of Standards,* Sept. 25, 1919.

The Cost of Electricity Supply.—John Hopkinson.—This article gives the full presidential address of Dr. Hopkinson delivered before the Junior Engineering Society, now the Junior Institution of Engineers, in November, 1892. The address is reprinted at this time on account of the extensive use which has been made of the Hopkinson method of charging customers for electrical energy consumed.—London *Electrical Times,* Aug. 21, 1919.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

This issue of the ELECTRICAL WORLD *is the sixth that has been published at Buffalo, N. Y., owing to the troubles in the printing trades at New York City, now over, as announced previously. It is the third and last of the combination issues arranged to make it possible to catch up with the calendar by the first of the new year.*

The Coal Situation

By the terms of an order issued in Washington Dec. 8, effective on that day, Dr. H. A. Garfield, United States Fuel Administrator, gave the Railroad Administration authority to issue regulations concerning the delivery, use and consumption of coal, coke or other fuel or of power generated thereby. The specific regulations apply to heat, light and power from bituminous coal and coke. Those referring to light are in substance as follows:

1. No ornamental lights, white-way or other unnecessary street lights, outline lighting, electric signs or illuminated billboards, show windows or showcase lights to be operated. This does not affect street lighting necessary for safety.

2. No cabaret, dance hall, pool hall or bowling alley to use light except between 7 p. m. and 11 p. m.

3. Stores, including retail, but excepting those selling food, and warehouses must not use light (except safety lights) except for six hours a day. Manufacturing plants to use light only during time prescribed for use of power.

Some exceptions to the above regulations are made as regards drug stores, railroad stations, hotels, hospitals, public buildings, dairies, bakeries, etc.

Restrictions on heat from bituminous coal and coke in substance follow:

1. Only enough may be used in offices, stores, warehouses and manufacturing plants to keep average temperature at 68 deg. Fahr., and then only during hours for which light is permitted. During other hours only enough heat to prevent freezing of water pipes or sprinkler systems.

2. Manufacturing plants or plants coming under power curtailment rules, heat (to 68 deg. Fahr.) allowed only during time prescribed for use of power.

Subject to a number of exceptions, the regulation governing power from bituminous coal and coke is in substance as follows:

No manufacturing plant or factory shall be furnished bituminous coal or coke or heat, light or power from bituminous coal or coke furnished by or through United States Fuel Administration for operation in excess of three days a week on basis of present working hours.

Electric railways must reduce schedules to minimum requirements of service under revised hours of heating, lighting and power as provided.

Since Dr. Garfield's order was issued the coal strike has come to an end. However, the regulations he made are accompanied by the warning that under the best conditions adjustment to a normal basis will take some time. The disorganization has been so serious and the need for coal supplies is so widespread that central-station executives will urge the greatest possible stimulation of production in the bituminous mines.

Scarcity of bituminous coal is giving oil producers an opportunity to interest large fuel consumers in a change from coal to oil. Much consideration is being given to the subject in New York, and reports persist that a number of stations, private and public, will use oil in whole or in part.

Summarized News

Principal Happenings Up to Closing of Forms for This Issue— Printed Dec. 15

Especially heavy buying is reported in the supply field, with particular emphasis on wiring material and every class of material which can be used in the household. Belated shipments of appliances are coming through and are temporarily filling up small gaps in the demand. It is generally realized that the end-of-the-year demand was not anticipated by jobbers and dealers early enough in the season to allow manufacturers to increase their output before the end-of-the-year rush. It is felt that air heaters will be shy before the winter is over as many jobbers' stocks are exceedingly low. Orders for table heating ware cannot be filled much before the end of the first quarter of the new year.

Electrical sheet manufacturers have their capacity booked up through the first and second quarters, depending on the company, and are not able to supply fully their regular customers' wants, sometimes not within 50 per cent. Rigid-conduit production is still behind and is liable to grow worse from lack of coal supply at the steel mills. Steel strip for armored conductors is in a similar condition.

From the several sections come reports of higher prices, some of which are local while others are nation-wide. Regulators, both generator and feeder, have advanced 5 and 12½ per cent, according to the manufacturer; outlet boxes are about 10 per cent higher; locknuts and bushings are up 25 to 40 per cent, and line hardware 10 to 12½ per cent. Locally, fiber conduit is reported 10 per cent higher, tape 12 cents a pound higher, silvered glass reflectors up 10 per cent, municipal signaling apparatus higher by 10 per cent, and pole treating charges up 20 per cent.

Particular shortages are felt in different kinds of conduit, outlet boxes, schedule material, small sizes of R.L.M. industrial reflectors, knobs and tubes. New England reports better socket production.

The drawn-filament lamp case of the General Electric Company against the Independent Lamp & Wire Company will be reargued before Judge Morris of New Jersey on Dec. 17. Briefs will be submitted by both sides, but the case will not be reopened.

Illinois is working only half time in compliance with the fuel conservation orders of the Illinois Public Utilities Commission. Its rules are being enforced in Chicago, by 125 of the Commonwealth Edison Company's commercial representatives, who are divided into day and night shifts. Transgressors are twice warned before their service is cut off.

A number of municipal electric plants in the Middle West are trying to buy central-station service because the private companies are better supplied with coal.

A new hydroelectric power plant and system is to be constructed at Challis, Idaho. Work is to start within sixty days.

A New York Section of the A. I. E. E. was organized at a meeting in New York on Dec. 10. H. W. Buck was elected chairman and H. A. Pratt secretary-treasurer.

The New York state conference of mayors has received assurances from governors of several states and mayors of a number of cities throughout the country that they will advocate the immediate enactment of the federal water-power bill now before Congress.

Heavy rains have caused flood conditions in the Gulf States. Power plants in several places have been reported inoperative.

Arrangements have been made whereby the Montgomery (Ala.) Light & Water Company will connect with the transmission system of the Alabama Power Company of Birmingham, Ala., for additional power. The Montgomery company will erect a 44,000-volt transmission line from Montgomery to Vidalia. The cost is estimated at about $500,000. S. B. Irelan is manager of the Montgomery company.

DR. C. O. MAILLOUX IS MADE PRESIDENT OF THE I. E. C.

Past-president of the American Institute of Electrical Engineers Honored by Selection as Presiding Officer of the International Body

Dr. C. O. Mailloux, who, as stated previously in the Electrical World, was unanimously elected president of the International Electrotechnical Commission for the next period of two years at the plenary meeting in London on Oct. 24, was the president of the American committee.

Dr. Mailloux was warmly acclaimed upon his election by his colleagues on the commission. His election was received with special interest by those with whom he has worked on the commission since its beginning in 1906. As

C. O. MAILLOUX

one of those who founded the commission he has worked effectively for its success and his selection is a recognition of his labors on its behalf.

The linguistic abilities of Dr. Mailloux have been of great service in facilitating the proceedings of the commission. They were valuable in the last meeting as on other occasions. A translation into French which Dr. Mailloux made of the address of A. J. Balfour was especially appreciated by the delegates.

The fifth president of the commission, Dr. Mailloux is the second American to hold that honor. Previous presidents have been Lord Kelvin, Dr. Elihu Thomson, Prof. Dr. E. Budde and Maurice Leblanc. He is a past-president of the American Institute of Electrical Engineers. He was the first editor of the Electrical World, serving in that capacity in 1883.

PLANS FOR 1920 REPORT OF OVERHEAD SYSTEMS COMMITTEE

N. E. L. A. Body Would Like to Get in Touch with Manufacturers Making New Devices for Line Construction or Maintenance Work

The overhead systems committee is planning in its 1920 report to bring to the attention of of the industry any new devices that, in the committee's opinion, would be useful in line construction or line maintenance work. In order to make the report as useful as possible the committee would be glad to get into touch with any manufacturers making such tools or devices for use in overhead-line work.

It is not the committee's plan to include in its report anything whatever regarding the various lines of standard fixtures that are on the market, but to call attention to special articles that might prove of particular value to operating companies.

Any data regarding such items should be sent to Mr. W. K. Vanderpoel, chairman of the overhead systems committee, at 80 Park Place, Newark, N. J.

PUBLISHES CALIFORNIA STUDY ON INDUCTIVE INTERFERENCE

Railroad Commission, Realizing the Widespread Interest in the Subject, Makes Available Selected Technical Reports

Results of the investigation carried on by the joint committee on inductive interference of the California Railroad Commission are now available in printed form. This committee was engaged for a number of years in exhaustive and painstaking investigation of inductive interference between electric power and communication lines. A large number of technical reports on many phases of the subject were made. The commission was asked to publish all or the most important of these. This it has done.

The volume includes selected technical reports with preliminary and final reports of the joint committee and commission's general order for prevention or mitigation of such interference. It represents the results of extensive field and laboratory tests and investigations carried on for over five years by electrical engineers from all parts of the United States, at an expense in excess of $100,000.

The work of the committee covered, together with theoretical studies, the field and laboratory tests of actual inductive interference between existing power and communication lines, transformer connection, loading, etc. Analyses were made of causes of inductive interference, magnitude, qualitative and quantitative effects under varying conditions, methods of prevention and mitigation of interference and special characteristics of the phenomena.

ELECTRIC PROPULSION OF MERCHANT SHIPS

W. L. R. Emmet, Before Society of Naval Architects and Marine Engineers, Expresses Belief in Its Wide Application

W. L. R. Emmet, consulting engineer of the General Electric Company, presented an address on the "Electric Propulsion of Merchant Ships" before the Society of Naval Architects and Marine Engineers in New York on Nov. 13 and 14.

"The use of electricity for propelling ships was first advocated," said Mr. Emmet, "in the case of large warships, in which it affords particular advantages in the matter of cruising economy through change of speed ratio, interchangeability, space distribution, etc. The first application, however, was made in the use of the United States collier Jupiter, which is in most features a ship of the merchant type. The demonstration of geared-turbine propulsion came after the first serious proposals of electric drive, and the advantages which have been attributed to the geared

method have suspended such activities as were considered in this country in the direction of electric drive for merchant ships, while, in the case of warships, electric drive activities have been uninterrupted. In the meantime certain electrically driven ships built in Europe, operated with very high degrees of superheat, have shown wonderful fuel economy, and many more such ships are being equipped.

"The larger American shipbuilders, having their own facilities for machinery construction, have not unnaturally been opponents of electric drive, and the Emergency Fleet Corporation, which for some time has represented ownership, has for various reasons discontinued such activities in this direction as had been planned.

"Two or three years ago the writer was of the belief that the geared equipments then being made afforded a solution of the problem which in cost and results would probably prevent commercial success of electric drive in merchant ships, although it was realized that the margin of possible advantage was small. Since that time improvements in electrical designs have been developed, and limitations of gear possibilities have appeared which put the question in a different light, and it is now the writer's belief that electric drive is justified in all large ships and that it will very soon develop a wide application, notwithstanding the great efforts of skill, organization and capital which have been given to the introduction of the gear drive for vessels of all classes."

A. I. E. E. TO ORGANIZE A NEW YORK SECTION

Board of Directors Approves Request for Organization, and Meeting Is Called for the Evening of Dec. 10 to Carry Out the Plan

At a meeting of directors of the American Institute of Electrical Engineers on Nov. 14 a petition was presented, signed by more than 100 members in New York City and vicinity, for authority to organize a New York Section of the Institute, to be conducted under the same general plan as the other thirty-four sections.

"The question of organizing a New York Section," writes Secretary F. L. Hutchinson, "has been discussed informally from time to time for several years past, but, as most of the monthly Institute meetings were held regularly in New York City, the need for a local organization was not so urgent as in the other cities of the country. In recent years, however, it has become more and more the custom for some of the Institute meetings to be held in other cities. The growth of the Institute membership and the industrial developments throughout the country make it more essential that in order better to fulfill its function as a national organization, an increasing number of meetings of the Institute, in addition to regular section meetings, must be held in the various cities of the country.

"This year, for example, an Institute meeting was held in Philadelphia in October, and others will be held in Chicago, Pittsburgh and Boston during the months of January, March and April, no meetings having been arranged to be held in New York City during those months. In order, therefore, that monthly meetings may be held in New York City whenever the Institute meetings are held elsewhere, it is considered by the petitioners essential that a local section be formed, thus placing the New York City membership on the same basis with relation to the Institute as the membership in others parts of the country."

The directors approved the request for the organization of a section in New York, and a special meeting for the purpose of organizing, electing officers and taking other action deemed desirable was called, to be held in the Engineering Societies Building, New York, on Wednesday, Dec. 10, at 8:15 p. m. This special meeting was to be in addition to the regular monthly Institute meeting to be held in New York on Friday evening of the same week.

POWER LOAD CURTAILED BY ONTARIO COMMISSION

By Cutting Off Outside Lighting and Lessening Domestic Service, It Is Planned to Reduce Niagara Falls Load 40 per Cent

In compliance with an order issued by the Ontario Hydro-Electric Commission, the Niagara Falls (Ontario) Commission on Dec. 2 ordered that all signs and outside lights be cut off and power users return to daylight saving, starting early and closing down at 4 p. m. Other restrictions are also imposed upon the domestic use of electric lights and heaters. The commission plans in this way to reduce the total load 40 per cent. The restrictions have been found necessary during the season of maximum yearly peak demands, owing to the large increases in lighting and industrial loads during the past year.

The order of the commission is as follows:

Owing to an emergency call sent out by the Provincial Hydro-Electric Commission, it is imperative that something be done immediately to limit the demand for electric energy. We therefore ask all consumers to co-operate as far as possible with the commission in trying to meet the present unusual situation. The only alternative to compliance is to see the city plunged in darkness by the cutting off of the main supply. This has already happened to more than one city in Ontario.

The commission has received orders to reduce the load to 60 per cent of our requirements. We advise that all signs and outside lights be cut off; that power users return to daylight saving, starting early and shutting down at 4 o'clock; that domestic users burn as little light as possible; that stoves be used sparingly and heaters not at all between the hours of 4 and 6 p. m., as the maximum load is reached between 4 and 6 o'clock. If a proper response results from this appeal, no further action will be necessary and the consumers will be notified immediate the trouble on the provincial system is remedied, so that they may return to normal conditions.

NEW GENERATING STATION FOR BRIDGEPORT, CONN.

United Illuminating Company Will Build Plant of 60,000 Kw. Initial Capacity—Power Needed for Industrial and Commercial Business

Real estate has been purchased by the United Illuminating Company, Bridgeport, Conn., on Pembroke Street, Bridgeport, for the site of a steam-turbine central station of 60,000 kw. initial capacity. Tidewater is available for condensing water and coal transportation at the new site. It is planned to transfer generating units from the Congress and John Street stations of the company to the new plant. There will be a coal storage capacity of 25,000 tons on the property, and the boiler plant will be equipped with the most modern coal and ash-handling machinery. Between 1914 and 1918 the station output of the Bridgeport division increased from 25,000,000 kw.-hr. to 81,000,000 kw.-hr., and the station rating from 10,000 kw. to 32,500 kw. During the war the population of Bridgeport increased from 120,000 to 170,000. Despite the fall-

ing off in war work since the declaration of the armistice, the industrial and commercial business of the United company has gone forward until the present generating facilities muse be supplemented in order to meet the increasing loads expected in the comparatively near future. It is estimated that the new station will be completed inside of two years.

ADVISORY COMMITTEES OF INTERNATIONAL COMMISSION

At London Meeting Advisory Committees Which Were at Work Before the War Were Reappointed and New Committees Created

Supplementing the previous report of the proceedings of the International Electrotechnical Commission, in London, Oct. 20 to 22, as sent by cable to the Electrical World, some details are now available from the London technical press. The London *Electrician* gives the following information:

It was unanimously decided to reappoint the advisory committees (formerly called special committees) which were at work before the war and appoint some additional advisory committees. These advisory committees were appointed as follows:—

Nomenclature.—The advisory committee on nomenclature was reappointed with one delegate from the national committees of each of the following seven countries: Denmark, France, Great Britain, Holland, Italy, Spain and United States of America. The advisory committee was requested to consider the terms and definitions which were agreed to in 1913 and to deal with those which were considered to require revision at the present time, the remainder to be published at once. The committee was then invited to continue the work and also to prepare terms and definitions for automatic telephone apparatus.

Rating of Electrical Machinery.—The advisory committee was renominated with one delegate from each of the national committees of the following seven countries: Great Britain, Italy, Sweden, Switzerland, Belgium, France and United States of America. It was agreed to publish the rules relating to the rating of electrical machinery agreed upon at the last meeting and modified in accordance with recent decisions. A cooling air temperature of reference of 40 deg. C. (the figure already adopted in the British, American, French and Italian rules) has been adopted unanimously. It was also agreed to limit the scope of the present rules to machines up to 750 kva. or 5000 volts, or armatures in length 50 cm., also the use of thermometer methods of measuring temperature under certain conditions in cases where resistance methods only were formerly permitted has been agreed upon. These international rules will shortly be published.

Symbols.—The advisory committee on symbols was reappointed with one delegate from the national committees of each of the following ten countries: Belgium, France, Great Britain, Holland, Italy, Denmark, Norway, Spain, Switzerland, United States of America. The advisory committee, in addition to revising I. E. C. publication No. 27, on symbols, has been invited to prepare a list of graphical symbols, including those for ordinary and wireless telephony and telegraphy.

Nomenclature of Prime Movers for Electrical Plant.—The advisory committee on the nomenclature of prime movers for electrical purposes was renominated with one delegate from each of the national committees of the following seven countries: France, Great Britain, Italy, Norway, Switzerland, Sweden, United States of America. This advisory committee was requested to reach agreement in regard to nomenclature of steam-driven prime movers for electrical purposes.

Aluminum.—An advisory committee consisting of one delegate from the national committees of each of the following eight countires, Frence, Great Britain, Italy, United States of America, Norway, Sweden, Holland and Switzerland, was nominated to study the question of the adoption of an international standard of resistance for aluminum, and it is desired that the lines adopted for the preparation of the standard of resistance of copper should be closely followed.

Screw Lamp Caps and Lamp-Holders.—An advisory committee consisting of one delegate from each of the national committees of the following seven countries, France, Great Britain, United States of America, Italy, Japan, Switzerland and Holland, was nominated to study this question, and it is understood that the report of the committee will deal with the question of international interchangeability, the question of material not being dealt with.

Charging Plugs for Electrical Vehicles.—An advisory committee consisting of one delegate from the national committees of each of the following six countries, Belgium, France, Italy, United States of America, Great Britain and Sweden, was nominated to deal with this subject. In this case, also, the question of interchangeability only is concerned, and it is understood that the charging plugs employed in the United States of America and Great Britain for tihs purpose are identical.

Pressures for Distribution.—An advisory committee consisting of one delegate from the national committees of each of the following ten countries was appointed to consider this question: Belgium, France, Great Britain, Italy, Switzerland, United States of America, Holland, Spain, Norway and Sweden. It was agreed to consider first of all a series of pressure steps for insulators, in accordance with the proposals of the Italian committee, and subsequently to consider the subject more generally.

NEW YORK RAILROAD CLUB HAS ELECTRICAL NIGHT

Recent Developments in Various Applications of Electricity to Steam Railroads Discussed —E. B. Katte Speaks

The fourteenth annual "Electrical Night" of the New York Railway Club—a meeting held at the Engineering Societies Building, New York, on Nov. 21—turned out to be the best-attended meeting in the history of the club. More than 600 persons were present. Recent developments in various applications of electricity to steam railroads were discussed. Among the papers presented were "Electrification of Steam Railroads," by E. B. Katte, chief engineer electric traction, New York Central Railroad; "Application of Electricity to Freight and Cargo-Handling Machinery," by Zenas W. Carter, Material Handling Machinery Manufacturers' Association; "Electric Welding," by H. A. Currie, assistant electrical engineer New York Central Railroad; "Electric Storage-Battery Trucks," by F. B. Fink, Elwell-Parker Electric

Company, and "Electric Car Lighting," by Alfred G. Oehler, associate editor *Railway Age*.

Mr. Katte gave a very concise résumé of recent developments in passenger and freight electric locomotives, presenting some interesting data thereon as well as illustrations.

Mr. Carter pointed out the possibility of reducing operating costs and getting along with shortage of labor and equipment by using electro-mechanical apparatus for freight handling. He referred to unique plans which have been proposed for handling freight in London by this means and also to an installation that has been completed at Cincinnati. Both installations involve the use of electric cranes, elevators, escalators, tractors, stacking and tiering machines, etc.

Mr. Fink emphasized the possibility of alleviating the labor situation, reducing costs, lightening toil, etc., by the use of electric trucks and tractors at piers, transfers, depots, shops, etc. He compared tractors, load-carrying trucks and electric crane trucks for different kinds of work.

Mr. Currie called attention to some interesting welding jobs that were accomplished during the war by railroads and the Emergency Fleet Corporation.

BOSTON "TECH" CONTRACTS WITH INDUSTRIAL CONCERNS

New Form of Arrangement Established in Connection with Campaign for Endowment Fund of $8,000,000 Appeals to Large Companies

The American International Corporation heads the list of industrial concerns which have signed the new contract with the Massachusetts Institute of Technology. In connection with its $8,000,000 endowment fund campaign the institute has gone out into the open market and offered its services to industry. The contract with the American International provides for $10,000 a year for five years. The Chile Copper Company has contracted for $2,000 a year for five years, the Simplex Wire & Cable Company for $1,000 a year on the same terms. This yearly payment is in the nature of a retainer's fee and varies with the size and needs of the corporation.

The General Electric Company already has a co-operative course with the institute and in addition has pledged $25,000 to the endowment fund campaign. Among the well-known concerns which have had the institute under contract for some years are the American Telephone & Telegraph Company and the Goodyear Tire & Rubber Company.

In consultation with the legal advisers of the institute, the following committee has drawn up a contract for the form of service outlined: William C. Potter of Guggenheim Brothers; Gen. Edmund Hayes, Buffalo; Henry Morss, Simplex Wire & Cable Company, Boston; Matthew C. Brush, president American International Shipbuilding Corporation, Hog Island, Pa., and Theodore N. Vail, chairman American Telephone & Telegraph Company. It provides that the institute shall receive a certain amount a year from the corporation in question in return for consultation privileges and the use of library and laboratory facilities. The whole faculty body of the institute is thus put at the disposal of the contracting corporation.

The "Electrical World" Street-Lighting Tables for 1920

Following its practice for thirty-one consecutive years, the Electrical World has prepared tables showing the proper time for lighting and extinguishing street lamps. The 1920 tables are now ready, and a copy will be sent free to any reader upon request to the Electrical World, Tenth Avenue at Thirty-sixth Street, New York. For more than one copy a charge of 10 cents per copy is made.

PREMIUMS OR NO PREMIUMS WITH WASHING MACHINES

No Decision Is Reached in Discussion on Effect of Premium Plan of Selling at Manufacturers' Meeting at Chicago

The principal theme of a two-day meeting of the American Washing Machine Manufacturers' Association at Chicago on Nov 19 and 20 was: "Is it or is it not good for the washing-machine business to have certain manufacturers giving premiums with washing-machine sales?" At a prior meeting a committee had offered a resolution condemning the practice, and this resolution was adopted by the association. At the latest meeting representatives of the manufacturer and the central station interested in the premium idea were asked to present their policy before the meeting. Those who were invited to address the meeting were: John F. Gilchrist, vice-president of the Commonwealth Edison Company and president of the Federal Sign System (Electric); John G. Learned, chairman Commercial Section, National Electric Light Association; W. W. Lowe, president Electric Appliance Company, Chicago, and Clarence G. Macey, a Chicago dealer.

Mr. Gilchrist said in substance: "A central station has three reasons for selling a washing machine. They are: First, the revenue from the electrical energy it will use; second, the merchandising profit, and third, the good will it creates by educating the customer to a better understanding of the value of electric service. The revenue from energy used by a washing machine is so small, however, that it is almost negligible. It usually amounts to $2 to $3 a year. However, because of the other values from washing-machine sales the central station can afford to sell washing machines even if the energy consumption were only $1 a year. Such low-energy use from the sale is not necessary, however, if each washer is sold in combination with some other device that will use energy.

"This and the appeal of the premium plan are the real reasons why the Commonwealth Edison Company is offering a floor lamp or coupons redeemable in electrical goods with each washing-machine sale. It has been found by experience that a customer will usually choose four high-wattage appliances in redeeming the coupons he gets with the washing-machine sale, if he does not take the floor lamp. This increases the annual revenue from energy sales by fivefold or sixfold with each washer put out."

Mr. Gilchrist added that he did not believe the effect on the industry as a whole was deleterious. He commented favorably on the fact that a new washing-machine store is being started next door to the Electric Shop at 72 West Adams Street, Chicago, and invited more manufacturers to establish their Chicago stores in that neighborhood in an effort to make it an important electrical shopping center.

AUTOMATIC TELEPHONES IN NEW YORK TERRITORY

Installations Now Being Made in Several Up-State Cities and Work is Planned for Manhattan Next Year—Operators Are Needed

After exhaustive investigations and long experiment the New York Telephone Company has developed a machine-switching central office system that has proved so satisfactory in a number of practical trials as to warrant its use in several places.

Installations are now being made in Dunkirk, Ithaca and Geneva, and the work is expected to be completed about the first of the year. In New York City it is planned to place this apparatus in the new "Pennsylvania," "Academy" and "Canal" central offices, but none of these installations can be completed according to present estimates much before the end of the next year. The latter changes are expected to help meet the abnormal demand for telephone service in New York City.

The telephone company is now carrying out a great reconstruction and expansion program to meet the heavy demand for service that has continued throughout this year and to regain the ground lost during 1917 and 1918, when no telephone construction other than that needed for government purposes was permitted. This year, in addition to a tremendous increase in the volume of traffic from existing stations, there has been a net gain in new stations installed since Jan. 1 of 100,000 in New York City and its immediate vicinity. As a result of this heavy demand for service, which shows no signs of diminishing, there are in many central office districts applications on file which cannot be taken care of without considerable delay. The new machine-switching system is, of course, designed to help in meeting these conditions.

The new system will not do away with the need for operators. There always will be work for large numbers of operators in toll, long-distance and private-branch exchange service and also in the central offices where the machine-switching apparatus is installed.

In New York City the operating force has been increased by 2000 new workers within the past nine months, and the telephone company intends to secure 1000 additional operators during the next few months. There will be no curtailment of this force, which soon will number 12,000. In fact, it undoubtedly will be enlarged, for even with the aid of the new machine-switching equipment a larger force of operators will be needed for some years in order to take care of New York City's growing demand for telephone service.

The new equipment is a natural development of existing Bell system apparatus. The switchboard equipment in telephone central offices is subject to almost continual change. The latest available improvement is the machine-switching apparatus, which is a development of the so-called semi-mechanical type used with success for several years in Newark, N. J. The new system will, therefore, be used in the larger installations of switchboards until something better is developed. Experience has shown that the best method of changing from one type of apparatus to another is to use the new type on all larger replacements and for taking care of growth so that the most modern types of equipment can be gradually brought into use with the least amount of disturbance to the service and loss of time and without any radical effect upon employees or upon the financial situation.

The new system has been so carefully worked out and the means of co-ordinating it with the other types of switchboards have been so perfected that the different types of equipment will interconnect without difficulty. In fact, a subscriber connected with one of the new switchboards will not need to know whether the called party is connected to a machine switching or a manually operated switchboard, and vice versa.

The system is extremely simple to operate. Instead of telling the desired number to an operator, the subscriber indicates it himself by manipulating a dial attached to the regular telephone instrument. This dial is equipped with ten finger holes, each carrying one of the ten numerals. In some cases the dials will be marked with certain letters of the alphabet. To call a number the subscriber simply places his finger in the hole corresponding to the first digit of the number desired, and pulls the dial around to the finger stop and then releases it, allowing it to return to its original position. He does this for each of the other digits of the number, and his connection is then completed automatically. If the called number is busy, an audible signal in the receiver apprises the calling party of that fact. To disconnect the receiver is hung up, just the same as at present.

In addition to the development in New York, installations of the new system are understood to have been made also in several cities in the territory of other Bell companies.

ELECTRICAL MANUFACTURERS' CLUB IN ANNUAL MEETING

Le Roy Clark Elected President at Gathering at Hot Springs, Va.—Addresses by W. G. Merritt and Dr. B. C. Tremaine

One of the most successful meetings in the history of the Electrical Manufacturers' Club was held at Hot Springs, Va., on Nov. 19 to 22. Addresses were made at the meetings by W. G. Merritt and Dr. B. C. Tremaine. Le Roy Clark, president of the Safety Insulated Wire & Cable Company, New York, was elected president for the ensuing year. The other officers elected were: Vice-president, Edward B. Hatch, Johns Pratt Company, Hartford, Conn.; secretary, F. L. Bishop, Hartford Faience Company, Hartford, Conn.; treasurer, Sears B. Condit, Condit Electrical Manufacturing Company, Boston; commissionary, F. W. Sanford, General Electric Company, Harrison, N. J.

Le Roy Clark, the new president, has been an active member of the club, of which he was vice-president last year. He is also actively interested in the Associated Manufacturers of Electrical Supplies and has been one of

the foremost supporters of the work of that organization. His work as chairman of the wire and cable section of the Associated Manufacturers of Electrical Supplies and then as chairman of the war service committee of wire and cable manufacturers particularly qualified him to take a responsible place in the federal government's war organization.

Mr. Clark served during the war as chief of the wire

LE ROY CLARK

and cable section of the finished products division of the War Industries Board.

Mr. Clark was graduated from Columbia University in 1894 and became electrical engineer of the Safety Insulated Wire & Cable Company that year. He was made president of the company in 1906.

CALIFORNIA WORK ON THE ELECTRICAL SAFETY RULES

S. J. Lisberger, Chairman of General Committee for Revision of Electrical Utilization Safety Orders, Co-operating with State Commission

Active investigation and study is being carried on by the committee for revision of electrical utilization safety orders appointed to co-operate with the California State Industrial Accident Commission. Organization of the general committee and the several sub-committees is now complete, and meetings are being held in both San Francisco and Los Angeles. S. J. Lisberger, engineer San Francisco distribution, Pacific Gas & Electric Company, is chairman, and during his absence in the East on a business trip Arthur Kempston, chief of the Department of Electricity, city of San Francisco, will act as temporary chairman. R. L. Eltringham of the commission is secretary of all committees.

Represented on the general committee are the following organizations: Pacific Coast Section, National Electric Light Association; League of California Municipalities, Board of Fire Underwriters of the Pacific, Pacific Telephone & Telegraph Company, California State Association of Electrical Contractors and Dealers, San Francisco Chapter, American Institute of Architects; American Society of Mechanical Engineers, American Institute of Electrical Engineers, State Building Trades Council, California State Railroad Commission, California Industrial Accident Commission, Electrical Manufacturers' Safety Association of California, Pacific District Council, I. B. E. W.; California Electric Railway Association, California Association of Electrical Inspectors, joint committee of the technical societies of Los Angeles, California State Federation of Labor, and California Electric Jobbers.

Altogether there are thirty-three members of the general committee, with five alternates. The sub-committees have been organized to study and draft recommendations upon a wide variety of subjects related to the various branches of electrical industry.

MORE GENERATING CAPACITY FOR BYLLESBY PROPERTIES

Installations for Several Systems, Together with New Stations to Be Built, Mean 100,000 Hp. Additional Before End of 1920

Rapidly increasing business in territories served by Byllesby electric properties has made imperative additional generating capacity. Three new power stations with a total initial capacity of 33,500 hp. have been planned for immediate construction, and further necessary additions and extensions are receiving the attention of the officials of the company.

One of the new stations will be situated in southern Minnesota, where demands of the Southwestern territory served by the Northern States Power Company have exceeded the capacities of the several divisions concerned. A new steam station will be constructed at this point and one 13,500-hp. steam turbine will be installed. Provision will be made for a second unit of 20,000 hp. to be installed later.

Condensing water for this station will be obtained from the Minnesota River and present equipment will include three 1165-hp. boilers with coal and ash handling machinery, etc. The improvement is expected to be completed within a year.

A new station with an initial capacity of 10,000 hp. will be constructed in western Oklahoma to take care of the growing demands upon the Muskogee, Sapulpa and Drumright divisions of the Oklahoma Gas & Electric Company. Condensing water will be obtained from the Arkansas River.

The third station will be constructed at Pueblo, Col., on the present power-house site of the Arkansas Valley Railway, Light & Power Company. The present power station with a capacity of 7500 hp. will be maintained and the new station with a present capacity of 10,000 hp. will be constructed adjacent to it. This improvement, like the others, is necessary because of increasing business in present territory and not because of expansion of territory.

With the new 40,000-hp. unit at Riverside station at Minneapolis (now under construction) and other enlargements or extensions at the properties either being built or contemplated, the combined properties will have available an additional 100,000 hp. of energy before the end of 1920.

DETROIT EDISON TAKES OVER PORT HURON COMPANY

Secures Both Electric and Gas Franchises with Increased Price for Gas After Submitting Proposition to Popular Vote

The Detroit (Mich.) Edison Company in September applied to the city of Port Huron for two franchises, one covering the conduct of a general electric light and power business and the other the operation of a general gas manufacturing and distributing business, with the understanding that if these franchises were granted, the company would acquire, take over and operate the then existing Port Huron Gas & Electric Company.

The electric franchise submitted provided that the rates for electric service in Port Huron should be the same as those in effect in the city of Detroit. The proposed gas franchise raised the existing rate for gas from 85 cents to $1.20 net per 1000 cu. ft. Both franchises were to run from a term of thirty years.

The city commission adopted both franchises, and as the state constitution provides that all franchises must be confirmed by vote of the people, they were submitted at an election on Oct. 27, at which time they were both confirmed by a large majority.

The Detroit Edison Company accordingly took over as of Dec. 1 both the electric and gas properties in the city of Port Huron and is operating them under the new franchises.

Port Huron is experiencing great industrial activity, and the company is planning to take care of the many urgent demands for both kinds of service.

FALL MEETING OF ELECTRICAL SUPPLY JOBBERS' ASSOCIATION

Co-operation of Jobber with Contractor-Dealer Is Keynote of Convention in Cleveland—Need for More Care in Stocking Lamps

The fall meeting of the Electrical Supply Jobbers' Association was held at the Hotel Cleveland, Cleveland, Ohio, on Nov. 18, 19 and 20. Among the divisional groups which met on the first day, the central division gave much consideration to the question of compensation of jobbers' employees. Because of the many entirely local factors affecting individual jobbers in different localities no definite action was taken on this subject. The Atlantic division was chiefly concerned with the question of co-operation between jobber and contractor-dealer. It was brought out that this system of distribution of electrical material had been put into operation in several localities with success, and the consensus of opinion was that it should be encouraged in general. This division passed a resolution, that a committee be formed to draw up a definite policy regarding merchandising. It was recommended that the jobbers lay down a policy and declare themselves.

Three sessions on the second day were devoted to discussions by the entire association. The keynote of the convention was the apparent approval by the jobbers of the plan of merchandising electrical material through the medium of contractor-dealers and electrical retailers. The spirit of co-operation between jobber and contractor-dealer was noticeable and was shown to be necessary to the successful working out of the plan.

In connection with the distribution of lamp stocks, Mr. Quinn, of the National Lamp Works, showed charts pointing out the many cases of excess stocks held by agents. It was brought out that these stocks could be cut down substantially if more care were taken in the appointment of lamp agents and greater assistance given by lamp distributers to agents so as to guide them to turn over stocks more rapidly. Mr. Quinn also showed charts setting forth results of an investigation of lighting conditions in industrial plants and the relatively small number of plants which were correctly illuminated.

PAYING FOR EXTENSIONS OF LINE IN CALIFORNIA

Inquiry Started by the Railroad Commission to Show Why Companies Should Not Be Required to Pay for Small Extensions

Representatives of seventeen companies appeared before the California Railroad Commission on Nov. 17 in answer to an order directing them to appear and show cause why they should not be required to make at their own expense all extensions for light and power service when the cost is less than $100. The commission also aims to probe utility methods governing deposit requirements based on extensions costing in excess of $100 and yielding to the company a revenue of 25 per cent or more above the cost of the extension.

Commissioner Martin, who is directing the investigation, in opening the hearing, said:

"The commission has in mind the establishing of certain principles and then to determine how far those principles can be generally applied. It is understood, of course, that there must be considerable flexibility; that the matter of the financial status and other circumstances attending upon the service and the field of the utility must be taken into consideration. The general idea is to have a rule of procedure to be adhered to as closely as the circumstances and the application of common sense and common understanding of all the conditions will permit."

R. H. Ballard, first vice-president Southern California Edison Company, declared that he did not think it advisable at this time to enforce stringent regulation. "Business," said Mr. Ballard, "is lopsided. Many conditions brought about by the war still prevail. We should have a year to catch up."

S. M. Kennedy, general agent Southern California Edison Company, said most of the trouble came from the small consumers and was due to their insistence upon service. He said that his company made it a practice to expend $80 toward the cost of the average lighting extension and that in the case of a power extension costing $1,000 the company would advance $600. The $400 deposit required of the consumer would be returned by credits on power bills.

Lester S. Ready, assistant chief engineer of the commission, asked Mr. Kennedy if his company made extensions when the prospective consumer chose to buy stock in the company to the extent of the cost of the extension rather than make a deposit.

"This has been done," said Mr. Kennedy.

ADDRESS OF A. J. BALFOUR TO INTERNATIONAL COMMISSION

English Statesman Expresses Hope that Progress of Standardization May Continue by Friendly Co-operation of All Nations

A. J. Balfour was a speaker at the dinner to the delegates of the International Electrotechnical Commission given in London on Oct. 21 by the British National Committee of the commission, the council of the Institution of Electrical Engineers and the council of the British Electrical and Allied Manufacturers' Association. Sir Richard Glazebrook, president of the British National Committee, presided. The presence of Mr. Balfour was of special interest to the delegates as he addressed the first plenary meeting of the commission held in London eleven years before.

Mr. Balfour said he deemed himself exceptionally fortunate in being able again to meet after all these years the representatives of the various countries interested in the great practical electrotechnical problems. The chairman had justly described Sir John Wolfe Barry as the father of standardization in England in that he initiated what was now known as the British Engineering Standards Association.

Since then much had happened. A great world tragedy had come upon us—a tragedy only in part overcome by the combined efforts of mankind. And the present meeting was a most successful attempt to do something to reknit the broken threads of this continuous undertaking in which their association was engaged. Mr. Balfour declared that he believed that undertaking to be one of the first importance for the future of mankind, in the first place because it was a branch of the great work of standardization, and standardization, as it seemed to him, was something in the nature of a development of the movement for the division of labor on which the efficiency of all human industry ultimately depended. Without division of labor we should be scratching the surface of the earth for a poor and inadequate livelihood. Standarization was not, indeed, parallel in magnitude with the enormous development which the division of labor had taken in modern society, but it was a deliberate attempt to make that division of labor as effective in as many branches of human effort as was possible. Standardization was a great labor-saving arrangement. Standardization carried with it as one of its inevitable consequences a diminution of that waste which arose from quite unnecessary individualism, either in the producer or the consumer of an article of commerce.

Standardization, added Mr. Balfour, was one of the means by which that waste was diminished, if not entirely prevented, and, therefore, perhaps they would say to him—not they, but some outside critic—standardization as just described must surely carry with it some diminution of that originality and individuality which was the source of all progress in the arts as in science, as in knowledge, as in philosophy, as in politics. He did not deny that that was a danger which had to be watched. He thought it was needful that those who produced should not be hampered in the full freedom of their inventive capacity by any artificial rules laid down by any society, trade or other organization. But he believed there was no danger attaching to their efforts, because they were all conscious that whatever was accomplished must be accomplished in the full view of the fact that nothing must be done to trammel human efforts or to prevent the freedom of human ideas for the progress and the augmentation of human well-being in the future.

Nor could there be any field in which that saving could be better effected than in the region of electrical industry. The speaker said he supposed the history of all electrical science and electrical practice showed that in the department of scientific and practical research the marriage of theory and practice had been more fruitful perhaps than in almost any other branch of human effort. If they compared what was known theoretically of electricity in 1819 and the practical use to which it was put at that time, which, he thought, might be regarded as zero, with what had been done in the 100 years that had elapsed in the happy combination of theory and practice, he thought they would agree that electrical science on its practical side had been more fruitful perhaps than in any other regions in which human ingenuity had exercised itself. There, most of all, it would be disastrous if we allowed any trammels of rules, any too rigid technical regulations, to hamper the free ingenuity of mankind. But that would not be so. Their efforts, he was convinced, would show more and more that theory and practice—although there were dangers in pressing either one side or the other overmuch—could be so combined that nothing should be lost from the point of view of economic production, and economic production on its side would not hamper but encourage the efforts of the pure man of science, who, although perhaps indifferent and sometimes even contemptuous of the result his investigations might produce, was perhaps the greatest benefactor of which modern society could boast.

There was a great deal of disputation, sometimes something worse than disputation, about the distribution of the products of modern industry. With those controversies they in that room had nothing to do, but Mr. Balfour felt that he was not going beyond what was his legitimate function when he expressed the firm conviction that the distribution of what was annually produced—for it was on what was annually produced that we lived—from day to day was nothing compared with the amount there was to distribute. Increase the products and the industries of the world, they could not leave the distribution alone; but if they were going to measure human well-being by human wealth and the way it was distributed they would get more by making human industry efficient and by the scientific conquest of Nature than by individualistic effort, however good, if undirected.

Economic manufacture, economic distribution—the manufacture and its distribution should be as little as possible interfered with by small human jealousies, oddities and weaknesses. Depend upon it if they, men of science, obtained that kind of production and increased it they would do more to increase the well-being of mankind than those who filled the newspapers were always ready to admit. It was to this that he looked forward as the great panacea for the material ills of life. He did not wish to underrate material well-being, but if they talked on that plane, then, he said, the work done by societies like theirs—modest, unostentatious, not appealing to the multitude, not occupying the attention of great mass meetings or eloquent orators—was going to do more than much that occupied the time and the patience of legislators.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Increase in Rates to Assure Day Service.—Rather than reduce the expense of operation through the discontinuance of daytime service by a utility not earning operating expenses under existing rates, the desire of the public for continuous electric service was effected by the Missouri Public Service Commission through an increase in rates of the Missouri Valley Light & Power Company at Eldorado Springs.

Priority of Service.—The Missouri Public Service Commission decided in a case affecting the St. Joseph Railway, Light & Heat Company that in the event that it is necessary to curtail the service furnished by a combined electric, heating and street railway utility priority in service is to be as follows: (1) steam-heating service, except during the morning and evening rush hours of the street railway; (2) street-railway service in general; (3) lighting service; (4) power service, the utility to notify power users a reasonable time in advance to prevent undue damage.

Rates in Conflict with Ordinance Terms.—Deciding a complaint raised by the borough of Beaver against the Beaver County Light Company the Pennsylvania Public Service Commission decided that in that state a public utility company may file a rate schedule in conflict with ordinance terms. "The only question submitted in this case is one fully answered by the opinion of the Supreme Court in Leiper vs. Baltimore & Philadelphia Railway Company," the commission says. "By the decision referred to it appears to be the settled law of Pennsylvania that both complainant and respondent are entitled to have reasonable and just rates for public service at all times, and the commission sits for the purpose of determining what rates are just and reasonable. Rates imposed by contract, like any other rates, must answer this test; if too high they may be lowered, and if too low the respondent may increase them. This equitable balance cannot be maintained if they are immutably bound by contracts entered into between the parties. A regulatory policy could not exist if it could not be made at all times to respond to the test of what is a just and reasonable charge for utilities to receive and patrons to pay in the light of conditions from time to time presented. Presently, when prices of labor and materials are moving upward, the tendency is toward rate increases, but when and if prices shall return to the former level, the trend will be in the other direction. As the complainant does not attack the reasonableness of the filed rates, but relies wholly upon the validity of the municipal contract, a matter disposed of by the Leiper case opinion, the complaint must be dismissed."

Operation of Unprofitable Utility.—Acting on the petition of the Marshfield Electric Company for permission to suspend operation temporarily the Missouri Public Service Commission has stated its position in part as follows: "It appears that the company had less than $100 in the bank at the date of the hearing, and attempts to borrow money were fruitless. At the date of the hearing the company had on hand only 16 or 18 tons of coal, and the manager stated that the coal companies with which he had been dealing refused to ship an additional supply until payment was made for past shipments. On behalf of the company an offer was made and dictated into the record to continue operation of the plant if the city would guarantee the actual expense of operation. Statement was also made on behalf of the president of the company that he was willing to leave the determination of the value of the property to disinterested parties if the city desired to purchase it. Contention was made by the city that a substantial rate increase would increase the company's revenue and relieve it of its present financial difficulties. The company's operating deficit is in excess of $300 per month. The present rates yield a total revenue of approximately $365 per month. It is, therefore, apparent that a rate of at least 30 cents per kilowatt-hour (or 100 per cent increase over present rates) would be necessary to pay the operating expense under present conditions, and this upon the assumption that this increase would cause no reduction in consumption. The real difficulty at Marshfield appears to arise because of the small proportion of citizens using electricity. While the city has a population of about 1500 and approximately 300 homes, there are only 190 connected consumers. An increase of rates would certainly not tend to increase the number of consumers, but would reduce the number of present consumers and the quantity of energy consumed. We are of the opinion that a rate increase within practicable limits offers no solution of the difficulty. The commission feels the greatest reluctance in permitting the discontinuance of lighting service to this city and its inhabitants. The commission would much prefer to require a continuance of service under all circumstances of every public service company of the state. However, the record in this case conclusively shows that this particular utility has ceased to be a going concern and actually causes its owner an out-of-pocket loss of approximately $300 per month. The city has recently voted a $15,000 bond issue for the purpose of purchasing an electric plant. The company has proposed to sell its plant to the city and to leave the determination of the purchase price to any disinterested party. The city has shown no inclination to purchase this plant or to install a new one so long as the commission requires continuation of operation by the applicant. It is not the purpose of the commission to exercise the power vested in it to place either party at a disadvantage in the sale negotiations. However, the commission is required by law to act upon and determine a case presented to it. The conclusion has been reached that the applicant should be permitted to discontinue operation of the electric plant at the end of a period of six months after the date of the order which the commission will cause to be entered herein."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Ordinance Must Exist for Complaint of Insufficiency of Rates for Municipal Service.—In order that the public utilities commission may proceed on a complaint filed by a public utility, under the provisions of the General Code, to fix rates to be paid to the utility for its service in a municipality, it is necessary that there should be an ordinance in existence passed by the municipality fixing the rate of charge complained of, and that the commission after a hearing shall find that the rate "so fixed by ordinance is or will be unjust or unreasonable, or insufficient to yield reasonable compensation for the service or product." (Village of Oak Harbor vs. Public Utilities Commission, 124 N. E. 158.)

Delegating Duty to Furnish Safe Tools to Employee.—Employer cannot delegate his duty to furnish employee with a reasonably safe place to work and reasonably safe tools and appliances by a contract with employee requiring latter to furnish his own tools and appliances. Where an experienced lineman who used his own tools, including gloves, having told his employer when hired that he preferred to so do, undertook to make repairs on high-power wires in his own way and with his own tools, using leather instead of rubber gloves, and placing the wires near each other instead of keeping them apart, so that he was injured when he touched them, he was guilty of contributory negligence, barring recovery. (Clements vs. Elizabeth City Electric Light & Power Company, 100 S. E. 189.)

Conditions Under Which Guy Wires Must Be Made Safe.—The duty of an electric power company was not absolutely to insulate or otherwise make safe its guy wires in any particular manner, but to make them safe under all the exigencies offered by the surrounding circumstances. In reaching a conclusion as to whether a power company was negligent in not guarding against the breakage of guy wires at the top as well as at the bottom, the jury should consider the nature of the country in which the pole was situated, the occupations of the persons living thereabout and the usual precautions taken under similar circumstances. Evidence held to justify finding that defendant electric power company should have anticipated that the guy wire supporting a pole carrying high-power wires might be subjected to sufficient strain, by contact with the usual instrumentalities employed in farming operations, to cause a breaking or tearing away of the strands of the wire and a consequent sagging, and should have insulated such wire so as to avoid injury to one working on the land. (Royal Indemnity Company vs. Midland Counties Public Service Corporation, 183 P. 960.)

Rochester Company Changes Name.—Stockholders of the Rochester (N. Y.) Railway & Light Company have voted to change the name to the Rochester Gas & Electric Corporation.

Arizona Power Resources.—Among the duties of the Arizona Resources Board, organized under an act of the last legislature, is that of gathering data and recommending means for utilization of water power.

New Offices of J. G. White & Company, Inc.—J. G. White & Company, Inc., announces the removal of its offices to 37 Wall Street, New York City. The company has recently enlarged its organization for the purpose of conducting a general business in the distribution of investment securities.

Only Six Men.—This small operating force is all that is necessary to run the principal generating station of the Great Western Power Company of California—one of the large hydroelectric power companies of the country. So states the circular of Lee, Higginson & Company, offering for sale the 6 per cent bonds of the company.

Vocational Training in the Army.—With $2,000,000 available during this fiscal year, the army has prepared a comprehensive plan of vocational training. In the electrical department radio specialists, linemen, telephone and switchboard operators, telephone and telegraph electricians, power linemen, interior-wire men and factory electricians will be taught.

New Committee for Ohio Electric Light Association.—A new committee known as the service committee of the Ohio Electric Light Association has been formed with the following membership: F. R. Coates, Toledo; W. A. Wolls, Columbus; C. W. DeForest, Cincinnati; E. E. Noble, Cleveland; E. H. Beil, Youngstown; L. H. Tight, Akron, O. B. Reemelin, Dayton, and J. C. Martin, Wilmington.

Transmission Lines in National Forests.—Because it greatly reduces the fire hazard, government foresters are doing all in their power to secure the introduction of electrical equipment in the national forests. In one case a lumber company operating in a national forest has installed more than a mile of electric transmission line through the woods to supply an electric logging engine with power.

"War Time Changes in Wages."—Average wages of men in eight leading industries, as measured by average hourly earnings, increased all the way from 74 per cent to 112 per cent during the period from September 1914 to March 1919, according to a report on "War Time Changes in Wages" issued by the National Industrial Conference Board. Increases in weekly earnings of men ranged from 62 per cent to 110 per cent. Percentage increases in earnings of female workers were broadly similar in the respective industries, with, however, a somewhat wider range. The eight industries included were metal, cotton, wool, silk, boot and shoe, paper, rubber, and chemical manufacturing. The average results are based on payroll data for one week, usually the third week of September, for the years 1914 to 1918 and for the first week of March 1919.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Ottumwa Company Purchases Additional Power.—The surplus hydroelectric power representing the amount over and above that required for pumping the municipal water supply will be sold by the city of Ottumwa, Iowa, to the Ottumwa Railway & Light Company on a wholesale basis, under the terms of a recently completed contract.

Italian Relief Fund to Honor Marconi.—Elihu Thomson, John W. Lieb and T. Commerford Martin as a special committee are soliciting funds for the Italian War Relief Fund of America as a special tribute in honor of Marconi. The committee was formed following a suggestion from Robert Underwood Johnson, president of the New York committee of the Italian War Relief Fund of America, that the moment is propitious for honoring the services to mankind of Marconi and at the same time for showing appreciation of Italy's great sacrifices and achievements in the war, by raising a special fund in the name of Marconi for immediate work in relieving the distress of Italian war orphans and blinded and mutilated soldiers and other war victims. It is hoped to raise $50,000 from those engaged in the electrical industries in America. Checks may be drawn to the order of S. Reading Bertron, treasurer, and sent to T. C. Martin, chairman of the special fund, at 29 West Thirty-ninth Street, New York.

Electric Power in Well Drilling.—Texas oil operators are greatly interested in the possibilities of electric power to replace steam plants in well drilling. It is reported that when the extensions of the high-power transmission lines now under construction are finished most of the well-drilling rigs in the several producing fields of central north Texas will discard their steam plants for electricity. It is asserted that it will mean an enormous saving in the cost of well drilling. Many wells in the Burkburnett field are already being pumped by electric power. Electricity is also available for large scopes of "wildcat" territory where extensive prospecting is in progress. The Empire Gas & Fuel Company is given credit for conducting extensive experiments in the use of electric power for well drilling that proved the cheapness and other desirabilities of this method. In one well in the El Dorado field of Kansas engineers of the Empire Gas & Fuel Company claim a saving of $3,655 by using electric power instead of steam power. S. B. Severson chief of the electrical engineering department of the company, in a report on the experiment says that this well was the first one drilled in that field by electricity, although hundreds of the company's wells are being pumped by means of electric power.

Nine-Million-Dollar Plant Wanted in Alaska.—John A. Davis, Governor of the Alaskan chapter of the American Mining Congress, said at the St. Louis meeting of this body that the power problem of Alaska would be solved if the government would erect a $9,000,000 power plant there. "Lignite for fuel is available in huge quantities," said Mr. Davis, "but the 30 per cent of moisture which it contains makes its cost excessively high when transportation facilities in Alaska are considered; but if this fuel is utilized in a central power plant in the heart of the lignite fields to avoid all transportation charges, and employs modern equipment designed to burn lignite to its best advantage, power could be generated and transmitted electrically to the mining districts at one-fourth to one-sixth of the present cost of generating it at the individual mines." Mr. Davis said he thought the plant should be built by the government just as the government is building the railroads for Alaska.

Plans for Manufactures Census Completed.—Special effort is being put forth to make the manufactures section of the approaching fourteenth decennial census the most complete and comprehensive inventory of the nation's manufacturing establishments ever taken, according to officials of the Bureau of the Census who have this work in charge. Schedules will be mailed to every manufacturing establishment in the United States during December so that factory owners and managers can familiarize themselves in advance with the questions to be answered when the records of the past year's business have been compiled. The questions relate to the calendar year 1919. In 1914, the year the last manufactures census was taken, about 275,000 manufacturing establishments were listed. This time more than 300,000 establishments will be sent schedules. In addition to this it is expected about 50,000 mines and quarries will also be reported. All information gathered by the census is strictly confidential, made so by act of Congress, and is for general statistical purposes only.

Utilities' Mutual Insurance in New York.—A booklet on the work of the Utilities' Mutual Insurance Company, New York, has been issued. It was issued with the idea of acquainting member companies with safe-practice methods and the important problem of industrial relations. This company has more than 200 utility companies in New York State. Its officers are James T. Hutchings, president; H. L. Mann, vice-president; Charles E. Morrison, vice-president and general manager; Charles H. B. Chapin, secretary; H. W. Peck, treasurer, and J. C. Montgomery, assistant treasurer. "Systematized accident prevention," the booklet says, "is an established fact. The causes of accidents are being removed one by one, and as a result there are fewer and fewer disasters and pleasanter and easier places to work in. . . . Inspection has become a science—while the employer, employee and the inspector constitute an alert triangle, co-operating continuously in the vigilant search for preventable accident causes." Organized in 1914, the statement of the company as of Dec. 31, 1918, shows total assets of $463,887 and a surplus of $244,615.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. A. E., Buffalo Chapter.—The Buffalo Chapter of the American Association of Engineers was recently installed by Dr. Frederick H. Newell, University of Illinois, who is president of the association.

A. I. E. E., Lynn Section.—Lieut. Parke H. Kemble, U. S. N., spoke on "Photographic Experiments in Air and on Land" at the Oct. 22 meeting of the Lynn Section of the American Institute of Electrical Engineers.

A. I. E. E., Schenectady Section.—F. G. R. Gordon, secretary of the American Anti-Socialist League, addressed the Nov. 7 meeting of the Schenectady Section of the American Institute of Electrical Engineers on "A Study of Socialism."

A. I. E. E., Panama Section.—"Steam Turbines" was the subject of a discussion given by J. J. Henry, senior chief engineer dredging division, Panama Canal, at the Oct. 11 meeting of this section of the American Institute of Electrical Engineers.

A. I. E. E., Pittsburgh Section.—"Some Experiences in the Development and Introduction of Submarine Detection Devices" was the title of an address made by C. E. Eveleth, engineer of the General Electric Company, at the American Institute of Electrical Engineers section's Oct. 14 meeting.

I. E. S., New York Section.—The Nov. 13 meeting of the New York Section of the Illuminating Engineering Society was devoted to a discussion of the various papers in a symposium on the application of the lighting codes which was given at the society's convention in Chicago last month.

N. E L.. A., Public Service Company, Northern Illinois Section.—The Public Service Company of Northern Illinois Section of the National Electric Light Association was addressed by Samuel Insull, president of the company, on the occasion of the section's annual meeting in Chicago Oct. 23.

A. I. E. E., Cleveland Section.—Alexander Churchward, consulting engineer of the Wilson Welder & Metals Company, New York City, spoke on "Thirty Years' Development in the Electrical Industry" at the Oct. 21 meeting of this section of the American Institute of Electrical Engineers.

Association of Railway Electrical Engineers.—At the eleventh annual convention of this association, held in Chicago, Oct. 28 to 31, the following officers were elected for the ensuing year: President, L. S. Billau, Baltimore & Ohio Railroad; senior vice-president, L. C. Hensel, Frisco Lines; junior vice-president, E. S. M. Macnab, Canadian Pacific Railway; secretary-treasurer, Joseph Andreucetti, Chicago & North Western Railway.

Cleveland Electrical League.—Prof. Vladimir Karapetoff, head of the department of electrical engineering at Cornell University, delivered an illustrated lecture on "The Coming Science of Acoustical Engineering" before the Cleveland Electrical League on Oct. 30. Another speaker at the meeting was Capt. S. N. Dancey of British Columbia, who argued for a definite alliance of the English-speaking nations as the safest guarantee of world peace.

A. I. E. E., Toronto Section.—"Turbine Design" was discussed by A. Aeberli at the Oct. 24 meeting of the Toronto Section of the American Institute of Electrical Engineers.

Pacific Coast Supply Jobbers Change Date of Meeting.—In order that its members might have an opportunity to attend the general meeting of the Jobbers' Association to be held at Cleveland on Nov. 18, 19 and 20, the Pacific Coast Electrical Supply Jobbers' Association changed the date of its Del Monte meeting to Dec. 4, 5 and 6.

A. I. and S. E. E., Philadelphia Section.—"Electrical Cleaning of Gases as Applied to the Blast Furnace" is the title of a paper by N. H. Gillert, president, and K. V. Laird, assistant electrical engineer, of the Gillert Engineering Company, Philadelphia, scheduled for presentation at the Nov. 1 meeting of this section of the Association of Iron and Steel Electrical Engineers.

A. I. E. E. Meetings to be Held in Connecticut.—Since the Yale University branch of the American Institute of Electrical Engineers is the only branch or section in Connecticut, the announcement that monthly meetings are to be held in New Haven under the auspices of this branch is especially interesting. The first meeting was held on Oct. 17, when Francis C. Pratt, vice-president of the General Electric Company, spoke of the war-time undertakings and industrial developments of that company.

Tennessee Electrical Contractors' Association.—Electrical contractors from Tennessee and adjacent states met in Memphis for the tenth annual convention of the Tennessee Electrical Contractors' Association, held on Oct. 14. An address was made by Samuel Adams Chase of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., on "Modern Practice in Electrical Merchandising," the subject being discussed from the standpoint of contractor and retailer. Mr. Chase was followed by J. A. Fowler of Memphis, secretary of the association, who spoke on "The Electrical Contractor and the Club Plan of Selling." W. R. Herstein, also of Memphis, addressed the convention on "The Jobber's Job." A banquet was given at the close of the meeting, William L. Goodwin of the General Electric Company, Schenectady, N. Y., being among the speakers. The election of association officers resulted as follows: S. P. Watson of Knoxville re-elected president; R. L. Clift of Memphis, first vice-president; J. P. Lawrence of Nashville, second vice-president, and J. A. Fowler of Memphis, secretary and treasurer.

Seattle Chapter of A. A. E. Formed.—A Seattle chapter of the American Association of Engineers has been organized in Seattle, Wash., with these officers: Charles E. Newhall, chemical engineer, president; Major Oscar A. Piper, vice-president, and Major Jesse A. Jeckson, secretary and treasurer. Both of the latter officials are members of the city's engineering staff.

A. I. E. E., Denver Section.—A special meeting in honor of Dr. Frank B. Jewett, lieutenant colonel Signal Corps, U. S. Army, and chief engineer of the Western Electric Company, was held in Denver, Col., on Nov. 6 under the auspices of the Denver Section of the American Institute of Electrical Engineers. The Colorado Association of Members of the American Society of Civil Engineers, the Colorado Section of the American Institute of Mining and Metallurgical Engineers, the Colorado Section of the American Society of Mechanical Engineers, and the Colorado Scientific Society participated in the meeting, which was preceded by a dinner. Dr. Jewett addressed the meeting on "Some War-Time Developments in Electrical Education and Allied Fields."

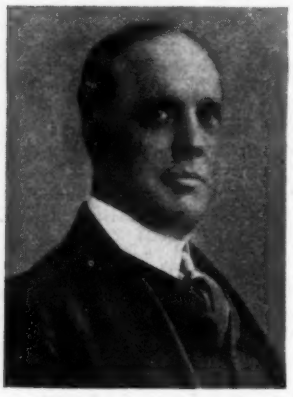
San Francisco Electrical Development League.—At the meeting of the league on Nov. 3 at the Palace Hotel W. H. Onken, Jr., editor of the Electrical World, delivered an address on "The Value of Publicity to All Elements of the Electrical Industry." Mr. Onken laid particular emphasis on the necessity of maintaining a proper public attitude toward the central stations and showed how this could be done through proper publicity. He urged the various elements of the electrical industry not to neglect this essential cooperation with the power companies. In the course of his address Mr. Onken paid a tribute to the enterprise and vision of the electrical men of the West. John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, chairman of the day, in introducing the speaker, dwelt upon the importance of the technical press in the upbuilding of the industry. E. O. Shreve, San Francisco manager of the General Electric Company and president of the league, presided at the meeting.

Ohio Electric Light Association Committee Meetings.—The station operating committee of the Ohio Electric Light Association met at Coshocton, Ohio, on Nov. 12. On the program were: W. H. Aldrich of Cleveland, "Recent Developments in Central Station Operating Practices and Devices"; Mr. Bascome, engineer United Service Company, "Operating Problems in Medium-Sized Plants," and C. Ridgeley Thrapp, manager Warwick Coal Company, "A Brief Talk and Chart Study of Coal Mining and Its Problems." C. H Howell, president Ohio Electric Light Association and manager of the Ohio Service Company, gave the luncheon address. The illuminating committee of the association met at Columbus on Nov. 14 and gave over its morning session to a general discussion and conference on illuminating committee work, including consideration of the recent survey of lighting improvements made in co-operation with local electrical interests. In the afternoon "The New Era in Lighting" was discussed by R. W. Shenton, and an address was given by Prof. F. C. Caldwell.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

PAUL M. LINCOLN, who for the past four years has been commercial engineer of the Westinghouse Electric & Manufacturing Company and prior to that was general engineer of the company, resigned from that organization on Nov. 1 to enter the consulting engineering field and in that capacity will have active charge of motor application engineering for the Lincoln Electric Company. Mr. Lincoln entered the electrical field in 1892 with the old Brush Electric Company of Cleveland. At the end of that year he joined the staff



P. M. LINCOLN

of the Westinghouse company. From 1895 to 1902 he was in the employ of the Niagara Falls Power Company, directing the operation of the first Niagara hydroelectric power plant, which he designed and installed. Mr. Lincoln was a pioneer in the development of tension transmission lines and among other things perfected the Lincoln synchronizer, for which he received the John Scott medal of the Franklin Institute. For many years Mr. Lincoln served as professor of electrical engineering in the University of Pittsburgh. In 1914 he was elected president of the American Institute of Electrical Engineers and for some time served upon its board of managers and upon its transmission committee.

C. E. ADAMS has been appointed manager of the Interstate Public Service Company, Lebanon, Ind., to succeed Ralph C. Roe.

RALPH C. ROE, formerly manager of the Interstate Public Service Company, Lebanon, Ind., has resigned to become manager of the Central Indiana Lighting Company, Bloomington, Ind.

H. E. WEIGHTMAN, who for several years has been engaged in consulting engineering work as chief engineer of the Engineering Service Company, Chicago, has accepted the position of director of the research division of the Atlas Electric Devices Company of that city, manufacturer of electric controlling devices, special arc lamps, color "Fade-ometers," etc. Mr. Weightman took up his new duties on Nov. 1.

J. T. DAY, manager of the Malden Electric Company, will also be manager of the Malden & Melrose Gas Light Company.

GEORGE HURN of the Haverhill Electric Company, who was acting manager during the overseas service of F. L. Ball, has been appointed manager of the company.

CYRUS BARNES, formerly new-business manager of the Malden Electric Company, has been appointed new-business manager of Charles H. Tenney & Company, with headquarters at Boston.

I. S. HALL, office manager for Charles H. Tenney & Company, Boston, has been appointed assistant to D. E. Manson, who is executive head of companies under the management of the Tenney interests, with headquarters at Boston.

ALEXANDER MACOMBER, assistant engineering manager, and John West, new-business manager for Charles H. Tenney & Company, have offered their resignations to organize the new engineering firm of Carver, Macomber & West, Boston, Mass.

E. F. PUTNAM, superintendent of the Greenwich district of the Connecticut Light & Power Company for the past four years, has been appointed superintendent of the Norwalk district. The new district to which he has been assigned includes Norwalk, New Canaan, Wilton and Georgetown.

H. M. WEST has resigned as commercial manager of the Harrisburg (Pa.) Light & Power Company to become associated with the Lexington (Ky.) Utilities Company in the same capacity. Previous to his connection with the Harrisburg Light & Power Company Mr. West was associated with Westinghouse, Church, Kerr & Company, New York.

EDWARD K. HALL, formerly vice-president of the New England Telephone & Telegraph Company, has been made vice-president of the American Telephone & Telegraph Company in charge of public relations and personnel. Mr. Hall was born in Illinois forty years ago and has been engaged in the legal affairs of the telephone business since graduation from a law school.

H. O. STEWART, who has been connected with the Rochester Railway & Light Company as engineer in the industrial department, has recently become production manager of Max Lowenthal & Sons of Rochester, N. Y. In his new position Mr. Stewart will make a complete survey of the motors in the plant with a view to obtaining efficient operation. Mr. Stewart was graduated from the Massachusetts Institute of Technology in 1909 after the completion of a scientific course at the University of Rochester in 1907.

B. W. GILSON, who was elected president of the Association of Iron and Steel Electrical Engineers, knows the requirements of the steel industry from thirty years of experience. He is a native of Pennsylvania and a graduate of Hiram College. After five years' experience in other steel plants Mr. Gilson became connected with the Ohio works of the Carnegie Steel Company at Youngstown, Ohio, where he has been for the past twenty-five years. He started at the bottom and has held practically every position in the electrical department from crane operator to superintendent. The latter position he has held for ten years.

C. F. UHDEN of Spokane, Wash., has been appointed special engineer to direct work in connection with the engineering of the proposed hydroelectric development on the Skagit River for the city of Seattle. Under the provisions of an ordinance passed in September by the Seattle City Council authority was conferred upon the board of public works to draw plans and specifications for the construction of a power plant at or near the mouth of Gorge Creek, capable of developing 50,000 hp. of electrical energy. Preliminary work has already been done on the project, which is estimated to cost $5,500,000. Mr. Uhden, who will draw the plans subject to the direction and approval of the city engineering department, is already familiar with the situation, having carefully inspected the conditions on the ground with City Engineer A. H. Dimock and D. C. Henny of Portland, a hydroelectric engineer. Mr. Uhden comes to the work well qualified by both ability and experience. For fifteen years he was connected with the Washington Water Power Com-

C. F. UHDEN

pany at Spokane, beginning as draftsman and rising to the rank of chief engineer. As chief engineer he constructed three hydroelectric power plants for the company, all of which are in successful operation to-day. The largest of these plants is at Long Lake and has a capacity of 90,000 hp. Construction of this plant is said to have involved problems very similar to those anticipated in building the Skagit project.

Ralph Neumuller has been appointed advertising manager of the United Electric Light & Power Company, New York City. Mr. Neumuller was formerly assistant advertising manager of the New York Edison Company and general manager of the Electrical Publications Syndicate.

L. O. Gordon, heretofore general manager for M. H. Grossman, successor to the Jackson (Miss.) Light & Traction Company, has become a member of the engineering department of the American Public Utilities Company at Grand Rapids, Mich. Mr. Gordon previous to entering the central station field was associated with the General Electric Company for about ten years in the Chicago, Minneapolis and Schenectady offices. He was also at one time manager of the Valparaiso (Ind.) Lighting Company.

A. E. Silver, who has been appointed chairman of the N. E. L. A. committee on inductive interference, has for a number of years been connected with the engineering department of the Electric Bond & Share Company of New York City in a general consulting engineering capacity. Mr. Silver has devoted his time particularly to high-voltage work as electrical engineer for the company in charge of design and construction of transmission and distribution lines and stations. He was born Aug. 14, 1879, at Dexter, Me., and he was graduated from the University of Maine with the degree of E. E. On graduation he took up the apprenticeship course with the General Electric Company and in 1904 joined the Raleigh (N. C.) Electric Company, where he developed a meter department. He later assumed the operating supervision of generating stations and overhead lines, and in 1906,

A. E. SILVER

when the Raleigh Electric Company was merged with the Carolina Power & Light Company, a subsidiary of the Electric Bond & Share Company, he continued in the same position with the new organization and was later appointed chief engineer and superintendent of construction. In 1910 he was called to the engineering department of the Electric Bond & Share Company. He acted as general consulting engineer, which position he still holds.

Fred Slater has resigned from the vice-presidency of the Texas Power & Light Company, Dallas, to engage in other business.

F. L. Ball, formerly manager of the Haverhill (Mass.) Electric Company, has been transferred to Fitchburg, succeeding C. R. Hayes as manager of the Fitchburg property, and A. G. Neal, who has been office manager at Fitchburg, has been appointed to fill the post of assistant manager in that city.

Frank C. Sargent has been appointed executive engineer of Charles H. Tenney & Company. Mr. Sargent will continue to make his headquarters at Boston, but will now be able to devote more time to problems of a consulting character than has been possible during his term of service as engineering manager for this syndicate.

Lester S. Ready, who has just been appointed assistant chief engineer of the California State Railroad Commission, for several years has been with the commission as gas and electrical engineer. Mr. Ready was graduated from the University of California, College of Mechanics, in 1912, and he had the high honor of winning the university medal awarded each year to the most distinguished scholar of the graduating class. Before joining the staff of the Railroad Commission he was with the distribution department of the Pacific Gas & Electric Company, San Francisco.

I. W. Alexander of the commercial department of the San Joaquin Light & Power Corporation has been appointed chairman of the publicity committee of the Pacific Coast Section, N. E. L. A., and also vice-chairman of the publicity bureau of the national association. Mr. Alexander received his early education at Stanford University and after two years' newspaper work he went to Fresno in 1915, where he became editor of the local organ of the San Joaquin Light & Power Corporation. During the past two years his activities have largely been exercised along lines of publicity work.

Major H. B. Joyce has been appointed manager of the power bureau of the United Electric Light & Power Company of New York City. Commissioned a captain in the Quartermaster's Corps and assigned to the chief construction division on Aug. 13, 1918, he was immediately placed in charge of the operation of all refrigerating equipment under the jurisdiction of that division handled by the maintenance and repair branch. A little later he was placed in charge of the section of the maintenance and repair branch handling the operation and maintenance of electric generation, distribution, and its utilization; heating equipment and its operation and maintenance, and refrigerating equipment, together with its operation and maintenance, which were under the jurisdiction of the construction division. These utilities were in about 370 separate and distinct locations scattered throughout the United States and its dependencies. He was promoted to major on May 28, 1919. On July 1, 1919, Major Joyce was placed in charge of the operating section of the engineering division of the corps.

William K. Vanderpoel, general superintendent of distribution for the entire system of the Public Service Electric Company in New Jersey, has recently been appointed chairman of the overhead systems committee of the National Electric Light Association. Heretofore the overhead-lines committee has directed its attention principally to standardization of line construction. This year the overhead-systems committee will bring the specifications up to date, but its principal activity will be to study outside maintenance methods and

W. K. VANDERPOEL

materials. In this field one of the chief efforts will be to secure exhaustive data on high-tension insulation performance. Compilation of agreements and practices in connection with joint-pole usage and keeping in close touch with the Bureau of Standards regarding the code will constitute other important phases of the committee's work.

W. R. Cooper has decided to retire from the editorial chair of the *Electrician* of London, which he has occupied for thirteen years, to devote the whole of his time to his consulting practice, which has grown considerably.

Obituary

Wallace E. Sawin, treasurer of the Holyoke (Mass.) Water Power Company, died at that city Nov. 7. Mr. Sawin was born at Holyoke and for many years wes employed in the engineering department of that company, finally being made chief engineer. He was elected treasurer in 1913 and was widely known as an authority on hydraulic engineering.

Percy H. Ashmead, one of the best known American engineers engaged in foreign practice, died on Nov. 12 at the age of fifty-two years. The development of railroads in China, Brazil and the Philippine Islands was his best known international engineering work. He was also head of the Costa Rica-Nicaragua boundary dispute arbitration commission. Mr. Ashmead was for many years chief engineer of J. G. White & Company.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

STEEL AND COAL STRIKES CAUSE SHORT PIPE SUPPLY

Heavy Orders for Rigid Conduit Remain Unfilled Through Shutting Down of Several Pipe Mills

Conditions of supply of rigid conduit have changed little for the better in the last few weeks. In fact, coal shortage has acted rather as a further deterrent factor in the supply market in that it has held up the resumption of work in steel industries where the effects of the steel strike had been overcome.

The steel strike affected the production of tubular goods more than it did the production of steel in general, and production since the beginning of the trouble has averaged about 50 per cent of the rate just before the start of the strike.

Production of rigid conduit in five mills is so badly curtailed that their output is hardly a factor in the market. The output of mills still in the running is sold up to six months, according to advices from one prominent manufacturer.

Jobbers, whose supply of pipe has been cut off, are having little success in securing stocks from other sources. Some had comparatively large stocks in hand and are still holding out. The sizes from ½ in. to 2½ in. are the shortest in the market, and 150 carloads of this material would be snapped up immediately in almost any large center were it available.

In the central part of the country, where large industrial and commercial building is more active than in other sections, stocks of conduit are spotty. In some quarters of this region buildings with steel work in place are being held up by reason of short supplies, according to the report of a manufacturer of conduit. In other places, however, jobbers report that contractors on construction in progress are supplied with sufficient material to complete the job.

The practice of stock guarantees is being resorted to, whereby in certain cases contractors are required to show stocks of materials or guarantees of stocks from jobbers before the builder will enter into a contract. This guarantee service of course carries with it an extra charge.

VIEWS ON FARM-LIGHTING PLANT GUARANTEES

Qualifying Phrases Not Generally Read or Appreciated—Salesmen May Only Emphasize Guarantee—Protecting Customers

At a recent meeting in Chicago farm-lighting-plant manufacturers expressed widely divergent views as to the necessity and desirability of guaranteeing their plants, but they very generally agreed as to the ethics which should be observed. It seemed to be the opinion that when apparatus becomes well known and the manufacturer has established a reputation for fair dealing guarantees are not always necessary, but many buyers expect a comparatively unknown manufacturer to show his faith in his product by guaranteeing it for a certain length of time.

Some objected to any broad long-term guarantee because it creates a contingent liability on the manufacturer which will result in either an increased selling price or a lower rate of return. It was admitted, however, that if the manufacturer could get the increased price from his customers, or was willing to take a smaller profit himself, no one had the right to object, provided always that the customers were given fair treatment. It was felt in this connection that a guarantee should always be so printed and advertised that it is not made to appear something which it is not, just for the purpose of getting business.

Guarantees were said to be treated in straightforward ethical manner in the national advertising of responsible manufacturers in the industry, and many companies also instruct their salesmen to make the customer understand the limitations of any guarantees that are made. However, some of the retailers are not conservative either in their statements or in their local advertising. To guard against misleading advertising by dealers some farm-lighting-plant manufacturers have put a clause in their dealer contract to the effect that all advertising copy must be submitted to the factory before it is run. This is having the effect of improving conditions in the smaller towns, but it is impossible to eliminate all misunderstandings and alleged misrepresentations as long as any guarantee is made.

LIMITATIONS TO WASHING MACHINE PRODUCTION

Output in 1919 of 500,000 Machines Not Likely to Be Exceeded Unless There Is a Larger Supply of Needed Parts

Copper and tin sheets, wringers and wringer rolls and motors are the three items of material used in washing-machine manufacture which to-day are limiting the production of the industry. In spite of present limitations caused by these shortages, the washing-machine industry expects to do a business of $50,000,000 this year, producing over 500,000 electric motor-driven machines. The tremendous growth which this industry has had may be seen by comparing this 1919 output with the seven-million-dollar output which the industry had about four years ago.

The situation in copper sheets, as explained to washing-machine manufacturers at a meeting in Chicago, is that the producers of this material have not yet been able to get back into their normal stride following the reduction in the tonnage of sheet material as a non-essential during the war. Representatives of producers of tin and copper sheets, however, expressed the belief that it was a matter of only a few weeks, or at most a few months, from now until it would be possible to take care of all of the demands of the washing-machine manufacturers for this material. The prices of this material, it was predicted, are not likely to be higher. The market recently on brass goods has been somewhat weak, but there has been no actual cut in the price of copper sheets. The suggestion was made that the use of nickel-plated sheet zinc might be investigated as a substitute for copper. This would effect a substantial saving in prices at the present cost, because plated-sheet zinc could be sold for around 22 cents a pound, while the price of finished copper such as is used by the washing-machine manufacturers is in the neighborhood of 41 cents a pound.

The wringer-roll situation is in a particularly bad shape. A representative of one large rubber company stated that his concern did not expect to increase its present output of wringer rolls for at least four or five months. He stated further that when it was ready to take wringer-roll business it looked very much as if the price would be about $1 per roll for a roll 11 in. long by 1¾ in. in diameter, with the washing-machine manufacturer furnishing the steel shaft.

Gossip in the corridors around the meeting of the washing-machine manufacturers seemed to indicate that the manufacturers of rubber rolls had not increased their capacity, largely because they believed it was only a question of time until the more important washing-machine manufacturers would produce their own wringer rolls. This would leave the rubber manufacturers with a large amount of equipment for the manufac-

ture of rolls and no possibiliy of securing business. That more washing-machine manufacturers have not already gone into the business of making their own wringers is perhaps due to the fact that the production of a wringer requires working three raw materials, namely, wood, metal and rubber. At the present time the wringer output of the country is practically in the hands of two large wringer concerns, and the washing-machine manufacturers were distinctly warned that a severe strike or a large fire at either one of these plants would seriously curtail the production of the washing-machine industry.

The motor situation was also viewed with some alarm. The washing-machine manufacturers are of the belief that they will produce 500,000 motor-driven machines this year, and they also understand that the total production of the small-motor industry of the United States is only 1,500,000 motors. This means that the demands of the washing-machine manufacturers alone will be one-third of the total production of the small-motor industry. That these figures must be approximately true is indicated by the state of that portion of the small motor market which is devoted to the washing-machine trade. Several of the motor manufacturers have recently raised the price on their motors for washing-machine service $2.60 each, bringing the price up to something over $16. In other cases washing-machine manufacturers are known to have paid a bonus of $3.75 per motor on lots of 1000 motors to get immediate delivery.

It is doubtful, therefore, if the price of washing machines for 1920 will be any lower. There have been several price increases in the months of October and November and more will probably come as the prices of motors, wringers, etc., advance.

While new washing-machine factories are springing up almost weekly, the demand for washing machines still seems to exceed the supply appreciably.

SCHEDULE MATERIAL PLANTS WORKING ON FULL TIME

Hesitation by Jobbers in Placing Stock Orders Early in the Year Responsible for Current Shortages in Wiring Supplies

Factories are working full time on schedule material but are far behind on orders. One of the largest plants in New England showed a representative of the Electrical World less than two loads of schedule material in stock Nov. 1. Materials are plentiful barring some shortages in composition. Labor is doing fair work although its latent powers are not fully exercised.

Hesitation on the part of the jobbers in the half year following the armistice is claimed by manufacturers to be the chief cause of the present shortage in pull sockets and other wiring fittings.

JOBBERS ORDER APPLIANCES FOR ENTIRE YEAR OF 1920

Good Sales Prospects and Fear of Continued Shortage Cause Them to Order Year's Supply for Proportionate Delivery Each Month

Jobbers in Chicago evidently think that this year's phenomenal business in electrical appliances will continue next year and also that appliances will still be hard to get. A number of jobbers have already placed orders with manufacturers for their supply of appliances for the entire year of 1920, and even more have placed orders for the first six months of the year. These orders are for a proportionate delivery each month and will be paid for at the price which prevails on the date of delivery. The orders are in general larger than the total of this year's orders as it is the opinion that the volume of sales will exceed that of 1919.

The "price at delivery" clause is in all the contracts as it is thought to be the most satisfactory method of compensation to the manufacturers for delivery at such distant dates.

The manufacturer has for some time been forced to place his orders for raw materials and some manufactured parts such as motors half a year or a year in advance, and now the jobber in order to have any assurance that he can meet the demands of his trade must follow the same plan. Furthermore, it is the opinion of jobbers that in future the dealer will have to follow the same trend. The jobber feels that the dealer should estimate his future demands and place his orders ahead as far as three months in order that they may be properly filled.

INCANDESCENT-LAMP "COMBINE" IS PROPOSED IN GERMANY

Negotiations Under Way for Amalgamation of A. E. G., Siemens-Halske and Auer Interests, Formerly Powerful in Foreign Trade

As a result of the action of the General Electric Company two or three years ago in refusing to license the importation of tungsten-filament lamps the American market for incandescent lamps has been reserved entirely for American interests. Whether the Canadian market will be similarly reserved to Canadian interests is now under discussion, and a decision is expected shortly. For the remainder of the world, however, competition can be expected between American, Dutch, English and German lamps, and, in the Far East, Japanese lamps also. Prior to the war German and Dutch lamps were the greatest factors in foreign trade. Since that time, however, Germans have not been able to export, and the Dutch through lack of bottoms and the nearness of the English market have confined their efforts largely to England. In the meantime the American export trade in tungsten lamps has grown by leaps and bounds and it is now running at an annual rate of 18,000,000 lamps, valued at $4,500,000, which is to be compared with 850,000 lamps, valued at $220,000, before the outbreak of war in 1914.

In this connection, therefore, it is interesting to note the proposed amalgamation of the lamp interests in Germany into one concern. There are only three tungsten incandescent lamp concerns in Germany, namely, the A. E. G., the Siemens-Halske and Auer. According to the latest report, the A. E. G. proposes to absorb the Auer electric incandescent lamp works, and it is also understood that a similar proposition has been or is about to be placed before the Siemens & Halske shareholders. If the proposed consolidation goes through, a separate concern will result, which will control the entire drawn-wire incandescent lamp production of Germany.

There are suspicions among the European trades that should this new concern be brought into being working agreements may be made with other wire lamp producers in Austria and Holland somewhat similar to the international agreements which existed for carbon lamps some time ago.

From this it is apparent that the German lamp producers have in mind an active competition in the foreign market with English lamps, the producers of which are again beginning to manufacture heavily, but more especially with American lamps, which have absorbed so much of the market that Germany formerly enjoyed.

LABOR-SAVING DEVICES ARE NEEDED IN EUROPE

Machinery Now in Use Must Be Replaced by Quantity-Production Machinery to Offset High Costs and Short Labor Market

A new demand for labor-saving equipment is arising in Europe, according to R. Sanford Riley, president of the Sanford Riley Stoker Company, who has recently returned from a three months' tour of that continent. In addressing the British Trade Conference at Boston on Nov. 20, on "Labor-Saving Devices in Europe." Mr. Riley pointed out that although labor has been cheap in England in the past, it is now the scarcest commodity there as elsewhere in the world.

A surprising amount of old-fashioned machinery is now in use in factories on the other side of the Atlantic, said the speaker, and these foreign countries will shortly be demanding the most advanced products of the machinery builder. In the interests of lower-cost living, cheaper production and production in greater volume are necessary abroad no less than in America. Mr. Riley contended that the commercial isolation of Germany, as preached during the war, is as great a mistake as sending a person to jail for debt.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Small Splash-Proof Direct-Current Motors

Small direct-current motors in ⅛-hp. and ¼-hp. sizes having splash-proof housings to protect the winding and the live parts from water or accidental contact have been placed on the market by the

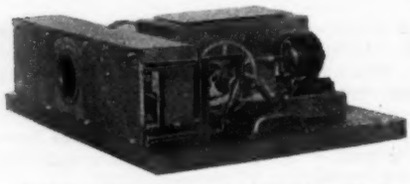
ADAPTED FOR LOW-VOLTAGE, STORAGE-BATTERY PLANT OPERATION

Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., and are known as type C0H. They can be used for light domestic and industrial purposes.

The new motors are wound for 32 volts and for 115 and 230 volts. They are interchangeable mechanically with alternating-current motors of similar ratings. The frame of the motors consists of a seamless forged-steel ring to which the cast-iron foot and end brackets are bolted. The pole pieces are bolted to the steel ring, thus permitting the use of form-wound field coils which are easily replaced in case of injury. Light weight and compactness have also been sought by the designers of the new motors.

Automatically Operated Stereopticon

An automatic electrically operated stereopticon which may be used for advertising purposes in stores and store windows and



SLIDES AUTOMATICALLY REPLACED AFTER TWELVE SECONDS SHOWING

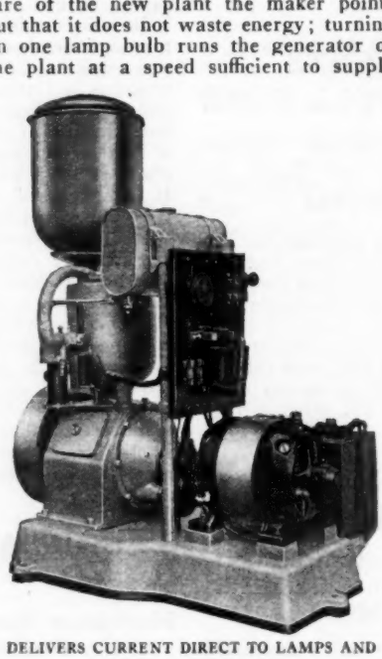
in many other places has been brought out by the Owen Automatic Stereopticon Company of Chicago, Ill. It is operated from an ordinary lighting socket and can be carried about in a suitcase.

The parts of the new stereopticon consist of the 1000-cp. nitrogen projection lamp, the condensing and objective lenses, a small General Electric universal motor, the slides and a screen upon which to project the pictures.

Batteryless Electric Power-Light Plant

A 110-volt farm lighting and power plant which has no storage batteries and which is started up from one, two, three or four remote points is now being produced by the Automatic Light Company of Ludington, Mich., and is known as the Holt plant.

This batteryless plant will furnish sufficient power, it is declared, for thirty 25-watt lamps or their equivalent. As a feature of the new plant the maker points out that it does not waste energy; turning on one lamp bulb runs the generator of the plant at a speed sufficient to supply



DELIVERS CURRENT DIRECT TO LAMPS AND POWER APPLIANCES

energy for that alone, and turning on additional lights causes an automatic electric governor to open the engine carburetor enough to take care of the additional load.

The gasoline engine used in the new plant is a single-cylinder, valve-in-the-head, water-cooled type. It is directly connected to a 750-watt General Electric compound-wound multipolar generator with a double commutator and two windings—one winding giving 110-volt current for the lamps and power appliances and the other 6 volts for the self-starting device. The control switchboard is mounted directly on the new plant, which is completely assembled on a base manufactured of iron.

Luminous-Top Reflector for Industrial Lighting

For use in factories with dark walls and ceilings the Benjamin Electric Manufacturing Company, 806 West Washington Boulevard, Chicago, has brought out an industrial lighting reflector with an opal-

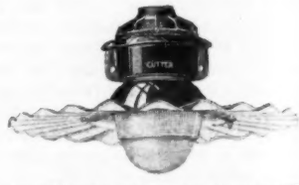
GIVES SOFT LIGHT IN UPPER PART OF ROOM

glass top through which is diffused a soft light throughout the upper part of the room, bringing out in detail the machinery, belting, pulleys, etc.

The new luminous-top reflector in its bottom uses a metal R. L. M. dome. Two sizes of these new reflectors are procurable, the 14-in. (35.5-cm.) size, recommended for 100-watt and 150-watt lamps, and the 16-in. (40.6-cm.) size for 200-watt lamps.

Street-Lighting Hoods

A new line of street-lighting hoods has been developed by the George Cutter Company of South Bend, Ind., for service on incandescent lamp systems. The enamel of the radial-bowl reflector of this hood, the producer states, is under no strain, and consequent cracking and rusting is avoided. The copper heel which forms the upper rim of the reflector takes



SUPPORTING POINT OF REFLECTOR IS OF COPPER

the pressure of two stationary lugs and a heavy set screw supporting the reflector. Three inside coats of white enamel and three outside coats of green enamel cover the steel reflector and overlap the bead which the edge of the reflector forms.

The porcelain heads for the series sys-

tems are designed for ample insulation and are arranged for either inner or outer wiring. When outer wiring is employed the wires may be tied in holes in the porcelain head's rim, making unnecessary the use of a cross-arm. The wires are led in to the socket terminals through holes.

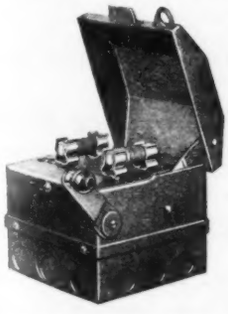
The cast-iron canopies, threaded for ¾ in. (19 mm.) on 1¼-in. (31.8-mm.) pipe and other iron parts, are electro-galvanized and painted black. The diffusers and refractors used with the hood are supported on hinges to allow easy access to the lamp. All parts are made interchangeable so that combinations may be made to suit different requirements of voltage intensity and distribution of light and manner of support.

Small Safety Motor-Starting Switches

A line of inclosed safety switches of unusually small size has been announced by the Trumbull-Vanderpoel Company of Bantam, Conn. The compactness of the switches allows them to be mounted directly upon motor-driven machines where space is limited. The door, it is stated, cannot be opened until the switch is off, in which position all fuse clips are dead, and when the door is open the switch cannot be closed by manipulating the handle or the fuse block itself. The upper section of the switch, containing all moving parts, is readily removable, and the lower section, constructed of a shallow pan fitted with knockouts, can be readily piped up. The upper section can then be easily replaced and may be sealed so as to prevent unauthorized removal.

This inclosed safety switch may be locked, preventing its operation and access to the fuse compartment, or the fuse compartment only may be locked. The fuse clips, it is stated, are made of extra heavy material and carry the switch contacts on their lower ends. The combined fuse clip and contact is free to move slightly in a lateral direction on the base, making the contacts self-adjusting, in addition to which self-adjusting fixed contacts of extra heavy metal are employed. The switch is quick-break.

The line includes two-pole, three-pole and four-pole switches, 30 amp. to 600



DOOR CAN BE OPENED ONLY WHEN SWITCH IS OFF AND FUSE CLIPS DEAD

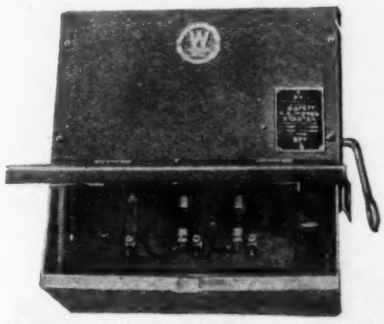
amp. inclusive, also motor-starting switches having an additional straight-through non-interrupting feature, rated at 30 amp. and 60 amp., all of the above being made in 250-volt and 500-volt sizes, as well as for 600 volts direct-current service.

Safety Starting Switch for Small A. C. Motors

For connecting single or polyphase alternating-current motors of from 1 hp. to 10 hp., 250 volts and 550 volts, directly to the line without the use of auto-transformers or resistance, an inclosed safety motor-starting switch, known as type WK-100, has been brought out by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa.

All of the new switch's mechanism, with the exception of the operating handle, is inclosed by a steel box. While the protective devices are easily accessible on opening a door in the cover, this door cannot be opened except when the switch is in the off position, nor can the switch be closed when the door is open, and all accessible parts are then dead. The upper part of the cover is held in place by screws and so can be removed without difficulty by authorized persons, thus exposing the entire mechanism of the switch to inspection.

No-voltage protection to the motor is provided by a magnetic release which opens the switch automatically on a failure of voltage. Over-load protection is provided by means of relays resembling cart-



DOOR CANNOT BE OPENED WHEN SWITCH IS "ALIVE"

ridge fuses in appearance, each of which contains a contact connected in series with the release magnet. Momentary overloads harmless to the motor are said to have no effect on the relays. The switch is so arranged that it cannot be kept closed on an overload or no-voltage, even if the handle is held in the on position.

The entire mechanism of the new starting switch is mounted on a slate base and can be removed as a unit without disturbing the box or the conduits, thus making for ease in replacing damaged switches.

Quartz Fibers

Quartz fibers for suspension in instruments where the property of being almost free from "elastic fatigue" when twisted through moderate angles is of advantage have been placed on the market by the Pyrolectric Instrument Company, 636 East State Street, Trenton, N. J., in two types, conducting and non-conducting.

They are supplied in boxes of a dozen, calibrated and marked, each fiber being 1 ft. (0.3 m.) long. The fibers are of assorted sizes down to the finest size possible to make. The conducting fibers have a uniform coating made from metallic platinum.

A Portable Projector with Hammered-Glass Reflector

For use at close ranges where it is to be not more than 125 ft. (38 m.) away from the surface or object to be illuminated, a portable utility projector has been brought out by the Western Electric

HAS A HAMMERED-GLASS REFLECTOR

Company, 195 Broadway, New York City.

With the new light operating on a 100-ft. (30-m.) throw, a spread of 100 ft. (30 m.) is said to be obtained at an angle of 60 deg. A 200-watt gas-filled lamp is used with a hammered-glass reflector suspended by a spring in a one-piece cast-iron housing.

The new lighting unit stands 19¼ in. (48 cm.) high, weighs about 30 lb. (13.6 kg.), has a handle and can be mounted on either vertical or flat surface.

Among the applications suggested by the maker for the portable projector are, in railroad work, lighting transfer tables, coaling stations, inspection pits, loading platforms, cranes, roundhouses and drawbridges; in marine work, lighting docks, dredges, slips, loading operations, canal locks, dry docks and pile drivers; in industrial plants, lighting shop yards, material yards, coal yards, well drilling, coal tipples, erecting shops, machine shops, tramways and inclines, conveyors and all kinds of emergency work. Other uses are illuminating playgrounds, skating rinks, signs, street corners, alleyways, swimming pools, monuments, flags, building fronts and construction work in general.

Silver-Clad, Platinum-Core Wire

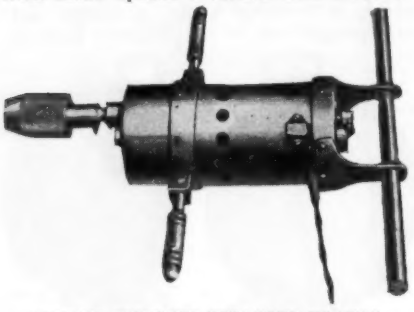
A wire having a platinum core 0.00006 in. in diameter and a silver covering with a diameter of 0.004 in. has been put on the market by the H. A. Wilson Company, 97 Chestnut Street, Newark, N. J., and is known as "Wollaston" wire. The silver outside of the new wire may be dissolved in acid, if desired, leaving the platinum core intact.

Combination Wrench Drill and Screwdriver

A light-weight portable electric tool that can be used as a power wrench, drill, screwdriver, grinder and buffer has been recently developed by Harold Hollingshead of 55 Liberty Street, New York City. An important advantage of the new tool pointed out by the maker is that it has a

mechanical clutch which automatically prevents stripping of the threads or breaking screws, nuts of bolts or the tool itself after the nut, bolt or screw is fully seated.

It has a small high-speed electric motor with three speeds forward and three in



CLUTCH PREVENTS BREAKAGE OF BOLT OR SCREW THREADS

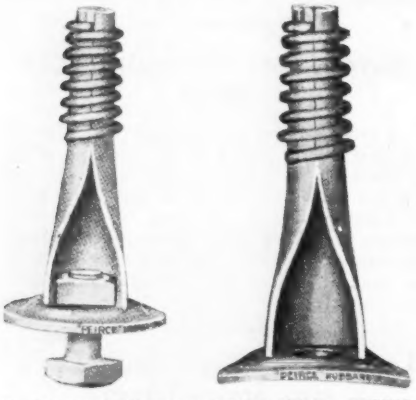
reverse. It operates on either direct current or alternating current of 110 volts to 120 volts. Power is transmitted to the shaft by a low-reduction double-right-angle worm and gear. This is said to make feasible smooth starting under varying loads.

The weight of the tool is about 14 lb. (6.3 kg.). Motor, rheostats, worms and gears are all inclosed in a metal cylinder.

Steel Pin for Wood and Steel Arms

A steel pin for use on primary circuits and distributing lines from high-tension lines, and which can be employed on any standard-size wood arm, on steel arms and on arms bored for any size of pin, has been recently put out by Hubbard & Company of Pittsburgh, Pa., and is known as the "Peirce Presteel" pin.

The new pin is fastened to the arm with either a ½-in. (12.7-mm.) or a ⅝-in. (15.8-mm.) through bolt. The nut fits within the body of the pin and is held from turning, the head of the bolt being tightened by a wrench. Because of this construction special stud bolts are unnec-



FLAT-BASE PIN WITH SHORT BOLT; CURVED PIN FOR ROUND-TOP ARMS

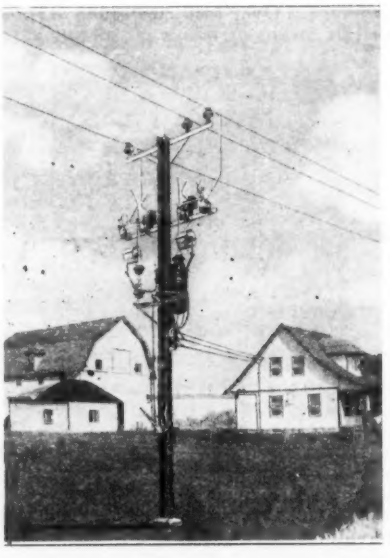
essary, stock machine bolts being used. The new pin has a broad-base bearing on the arm in order to reduce to a minimum the strain on the bolt. Open-hearth steel is used in making the pin, which is hot-galvanized. It is equipped with "Peirce" spring threads. Two types of the new pins are made—flat-base for flat-top arms and curved-base style for round-top arms.

Automobile Radiator and Engine Heater

A portable radiant-type electric heater which operates on an ordinary lighting socket and is hung on the radiator cap of an automobile, thereby heating the radiator and the engine and so keeping the water in the cooling system from freezing, has been placed on the market by the Majestic Electric Development Company of Philadelphia and San Francisco. It has a polished copper reflector with a guard and a glowing coil-heating element.

Unit-Type High-Tension Farm Equipment

A unit-type high-tension, single-phase equipment for farm-line service has been developed by the Delta-Star Electric Com-



TWO-POLE SWITCH IS OPERATED FROM GROUND LEVEL

pany, 2433 Fulton Street, Chicago. It comprises a two-pole switch with choke coils, fuses and lightning arresters, the switch being operated from the ground level.

The farmer can safely replace blown fuses since when the switch is open all the apparatus, including the arresters, is disconnected and becomes automatically grounded.

Cold-Junction Correction Thermometer

A correction thermometer which can be used at the thermocouple head or at any convenient point to take care of cold junction has been developed by the Pyrolectric Instrument Company, 636 East State Street, Trenton, N. J. Corrections are given on it directly in degrees, plus or minus, for either Centigrade or Fahrenheit scales as specified.

Recent Appliances

Electric Vacuum Cleaner

The Air-Way Company of Toledo, Ohio, is now making an electric vacuum cleaner known as the "Air-Way All-in-One."

Industrial Storage Battery Locomotive

The Atlas Car & Manufacturing Company, Cleveland, Ohio, is now making type A and type B storage battery locomotives for industrial application.

Transformer for Electric Toys

The A. E. Rittenhouse Company of Honeoye Falls, N. Y., has placed on the market a transformer for operating toys for 110-volt lighting circuits.

Outlet and Junction Boxes

No stove bolts are used for holding in place the outlet boxes which are now made by the Toledo Metal Products Company, 956 Spitzer Building, Toledo, Ohio.

Semi-Indirect Lighting Unit

The Luminous Unit Division of the St. Louis Brass Manufacturing Company of St. Louis, Mo., has added type WF "Brascolite" to its line of semi-indirect lighting fixtures.

Portable Motor Drive for Tools

For operating hand pipe-threading and cutting tools the Toledo Pipe Threading Machine Company, Toledo, Ohio, is now making a portable motor drive mounted on wheels.

Electric Vacuum Cleaner

The Philadelphia Electric Company, Supply Department, 132 South Eleventh Street, Philadelphia, has brought out an electric vacuum cleaner known as the "Franklin."

Portable Electric Sewing Machine

A portable electric sewing machine known as Greyhound-U has been placed on the market by the New Home Sewing Machine Company, 47 East Seventeenth Street, New York City.

Electric Washing Machine

The H. E. Williamson Company of 1340 Mission Street, San Francisco, Cal., is now manufacturing for domestic use a cylinder-type electric washing machine with a gas-burner attachment.

Reflector for Sewing Machine

The Goldman Sav-A-Lite Company of 439 Sixth Avenue, New York City, has developed a shade which directs the light of one lamp to four sewing machines.

Electric Lanterns

Two electric lanterns, one for automobile and general utility use and the other for railroad purposes, have been placed on the market by the Conger Lantern Company, 2656 Madison Street, Portland, Ore.

Manufacturers' Activities

THE CHATTANOOGA STAMPING & ENAMELING COMPANY, Chattanooga, Tenn., announces that it has discontinued its electrical line.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY announces the discontinuance of manufacture of its 2-qt. sterilizers.

THE ELECTRIC WELD COMPANY, manufacturer of electric goods in Marlboro, Mass., for the last ten years, has moved to Munroe Street, Lynn, Mass.

F. P. GATES, assistant manager Arrow Electric Company, Hartford, Conn., has resigned to become superintendent of the Hart Manufacturing Company, Hartford.

EDWARD WRAY, assistant general manager of the Sangamo Electric Company during the past two years, has resigned, effective Sept. 1, on account of ill health.

THE ADVANCE ELECTRIC COMPANY has moved its factory for the manufacture of small motors from 20 North Commercial Street, St. Louis, Mo., to 6313 Maple Avenue, in the same city.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY announces the appointment of Vernon R. Buxton to the Boston sales office as switchboard specialist in the supply department.

THE BRUNNER MANUFACTURING COMPANY, Utica, N. Y., manufacturer of small air compressors, advises that in the near future it expects to have some new models ready for the trade.

THE RAWSON ELECTRICAL INSTRUMENT COMPANY, 4 Norfolk Street, Cambridge, Mass., announces that its molding department is equipped to produce molds and molding of condensite material.

THE STANDARD SEWING MACHINE COMPANY, Cleveland, Ohio, announces that it is working up a different design of electric motor for sewing machine drive which is not yet ready for the market.

THE A. C. GILBERT-MENZIES COMPANY, Toronto, Canada, states that the Wallace lamp is now being put out in lots of one dozen in assorted finishes, brass, bronze, nickel and verde enamel.

THE ATWATER KENT MANUFACTURING COMPANY, Philadelphia, announces change of name to the foregoing from its former name, Atwater Kent Manufacturing Works. There have been no changes whatever in the product or character of the organization, which was started in 1900. The product, consisting of ignition, starting and lighting equipment for automobiles and motors, is distributed to every branch of the trade, direct to owner, direct to dealer for resale, to jobbers for resale to dealer and to car manufacturers for use as regular equipment. A. Atwater Kent is president and treasurer, Walter J. Little vice-president and general manager, and H. E. Rice is sales manager.

LARGE FURNACE EQUIPMENT ORDER SHIPPED.—The Westinghouse Electric & Manufacturing Company announces that it is shipping from the United States electrical equipment for twenty electric furnaces, which when placed in operation will compose one of the largest electric furnace installations ever made. The shipment is destined to the Glomfjord Smeltverk Company, Glomfjord, Norway. Each unit includes a 1300-kva. single-phase main power transformer, a 26.2-kva. series transformer, a 26.2-kva. induction regulator, an automatic selector switch, a transformer switch, and a two-panel separately mounted switchboard for the control of the electrical apparatus. In addition, 16,200 gal. of oil for insulating and cooling the transformers and regulators is a part of the shipment.

THE PAGE & HILL COMPANY is building a new yard, office and laboratory at its Minnesota transfer plant.

WILLIAM L. SWORMSTED has been appointed manager of the Washington office of the Westinghouse Lamp Company, succeeding C. R. Whitney, resigned.

THE VOSS BROTHERS MANUFACTURING COMPANY, Davenport, Iowa, is erecting a four-story brick and concrete extension to its plant. The building will be 150 ft. by 60 ft., with an "L" 30 ft. by 40 ft., and will cost $125,000.

THE TIDEMAN ELECTRIC MANUFACTURING COMPANY announces that in its complete new plant at Cairo, Ill., it will devote its entire attention to the manufacture of Menominee fans and motors. The fans are made in 9-in., 12-in. and 16-in. sizes, and the motors from 1-50-hp. to 1-hp.

THE ROLLER-SMITH COMPANY, 233 Broadway, New York City, announces the appointment of the General Machinery Company, Brown-Marx Building, Birmingham, Ala., as its agent in the States of Florida, Georgia, Alabama and Tennessee. The personnel of the General Machinery Company consists of B. A. Schroder, president, and W. H. Price, sales engineer.

THE ANDERSON ELECTRIC SPECIALTY COMPANY, Chicago, has leased for fifteen years commencing May 1, 1921, a building containing 75,000 sq. ft. of floor space, at 154-160 Whiting Street. The company occupied only 8000 sq. ft. of space three years ago, and its present quarters contain 18,000 sq. ft., or less than one-quarter that which will be made available in about eighteen months.

THE PIERCE FUSE CORPORATION, Buffalo, N. Y., announces that Emory M. Coffin, formerly of the sales department of the Franklin Incandescent Lamp Works of the Westinghouse Lamp Company, has been appointed assistant sales manager. B. F. Perry, formerly district manager of the Franklin Electric Manufacturing Company, Pittsburgh, Pa., has been appointed Pittsburgh district manager of the Pierce Fuse Corporation.

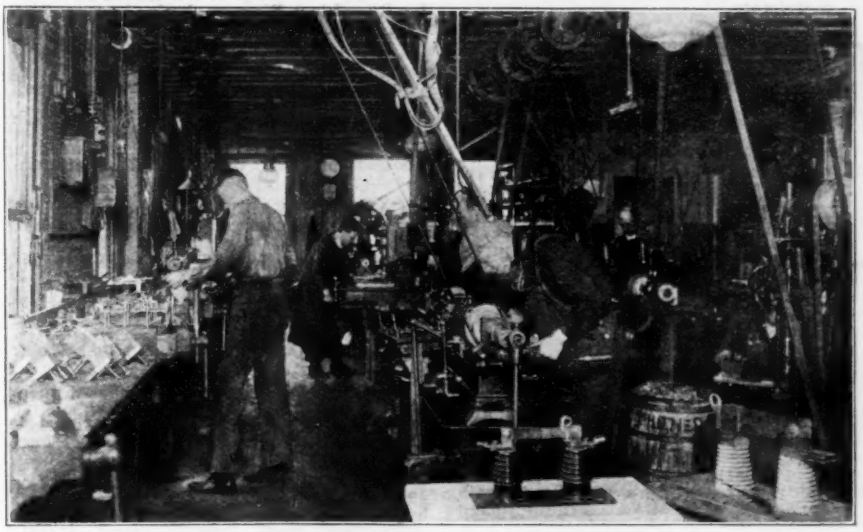
THE PARSONS-MOOREHEAD MACHINERY COMPANY, Hostetter Building, 237 Fourth Avenue, Pittsburgh, has been organized to do a general machinery business. William L. Moorhead of this company was formerly vice-president of the Duquesne Electric & Manufacturing Company, while Mr. Parsons has been doing a general machinery business for several years.

WARREN, WEBSTER & COMPANY, Camden, N. J., announces the resignation of Frank G. Phegley after nine years of service as manager of the Cleveland office. Mr. Phegley expects to enter the professional field as consulting engineer in heating and ventilating work. The Cleveland office will be maintained at the same location, 706 Rose Building, but will hereafter be under the direct management of the home office. Clyde W. Colby has been appointed Cleveland district manager, with William Roebuck, Jr., as assistant.

THE SIGNAL ELECTRIC MANUFACTURING COMPANY, Menominee, Mich., announces that it has acquired the plant, good will and manufacturing rights of the Tideman Electric Manufacturing Company in the field of Menominee electric bells, medical batteries, telegraph and wireless instruments. The company will devote its entire energies to these four lines of electrical apparatus, the distribution of which will be through the regular channels of the Tideman Electric Manufacturing Company, as heretofore.

THE ROLLER-SMITH COMPANY, main office and export department, 233 Broadway, New York City, manufacturer of electrical protective and measuring apparatus, announces that it is now represented in Cuba by Martinez, Cartaya & Bueno, Muralla 40, Havana, Cuba. Martinez, Cartaya & Bueno, who represent also the Wagner Electric Manufacturing Company, will handle the Roller-Smith products of electrical measuring instruments, watt-hour meters and circuit breakers on an exclusive agency basis for the entire island of Cuba.

THE CHATTANOOGA ARMATURE WORKS, Chattanooga, Tenn., has just completed a portion of its plant, making an addition of 3000 sq. ft. to its floor space. The old frame building was removed and brick construction substituted. It has now complete repair shops to take care of electrical machinery and special coils. The company manufactures armatures and field coils for the different makes of motors and generators and represents the Van Dorn Electric Tool Company and the Lincoln Bonding Company, both of Cleveland, Ohio.



MACHINE SHOP OF THONER & MARTENS, BOSTON

Thoner & Martens, Boston, Mass., have received an order for a number of 20-000-amp. heavy-duty rotary switches for the New York Edison Company. These switches, which are the largest manufactured by this firm, weigh 2500 lb. each and are of the selector type.

Supply Jobbers' Notes

L. J. LIBBING & COMPANY, INC., 205 East Main Street, Fort Wayne, Ind., will file articles of incorporation on Jan. 1, 1920. The new company will wholesale and retail electrical supplies, appliances and farm-lighting plants and has already bought heavily in anticipation of an advance in market and slowness in delivery. L. J. Libbing is president, Joseph C. Eliert vice-president and general manager, D. O. McComb second vice-president, and William J. Barth secretary and treasurer. The company will also engage in armature rewinding and other electrical repairing. The present L. J. Libbing & Company has occupied this location for the last twenty-four years.

THE AMERICAN CONSOLIDATED ELECTRIC COMPANY, 30 Clinton Street, Newark, N. J., announces the names of its officers as follows: F. A. Schiller, president; L. E. Cotsen, vice-president; J. H. McCauley, treasurer; L. F. Schiller, secretary. The company has no sales manager, but F. A. Schiller, as general manager, directs sales from the Newark office, while L. E. Cotsen is in charge of sales in the Boston office at 221 Columbus Avenue. The company was formerly conducted under the same name with F. A. Schiller as proprietor. No manufacturing is done, but at this time there is distributed a complete line of incandescent lamps and automobile bulbs, while the company contemplates distribution through jobbers or agents.

THE CARROLL ELECTRIC COMPANY, Washington, D. C., jobber of electrical supplies and machinery, has made this statement to the "Electrical World" of the results of its policy of co-operation with the contractor-dealer: "A campaign launched in Washington by the company in conjunction with the Westinghouse Electric & Manufacturing Company more than a year ago for active, practical co-operation between jobber and contractor has resulted in a greater volume of business not only for the jobber but for the contractor-dealer. At the present time there is a most friendly spirit and desire for practical every-day co-operation. Within the last year contractors who formerly gave little attention to merchandising now have attractive stores with show windows and have laid a foundation for future successful merchants. It has been a great stimulus to the trade generally and has awakened among contractors a strong interest in becoming successful merchants."

Foreign Trade Notes

JUAN E. MUZIO, Calle Agote, N. 91, Buenos Aires, Argentina, is in the market for American electrical goods and would like to have catalogs and descriptive matter.

JONES, BURTON & COMPANY, LTD., engineers, Liverpool, desire communication with manufacturers of portable electric drilling machines with a view to representing manufacturers of that equipment in England.

TRACKSON BROTHERS, LTD., Bisbane, Australia, wishes to represent American electrical manufacturers in Queensland, Australia, especially in motors and electric specialties. The company has been established since 1884 and is represented in New York City by Strong & Trowbridge, 17 Battery Place. The company is already representing a number of well-known American electrical manufacturers in Queensland.

G. R. DRUMMOND, general manager of the Lahore Electric Supply Company, Ltd., Lahore, India, invites tenders on the following equipment: One 1000-kw., three-phase, 6600-volt, 50-cycle turbo-alternator; one 500-kw., three-phase, 6600-volt, 50-cycle turbo-alternator; high-tension station distributing system for above; water-tube boilers and equipment; ten motor-generator sets, switchboard, high-tension and low-tension distribution equipment for substation on line. The time of shipment is important in the awarding of contracts. For further information address the "Electrical World."

Trade Publications

DRY CELL.—The Twin Dry Cell Battery Company of Cleveland, Ohio, is circulating a folder on its "Twin" dry-cell battery.

LETTER OPENER.—The Ries O. K. electric letter opener is illustrated in a circular issued by the O. K. Manufacturing Company, Syracuse, N. Y.

LIGHTING UNIT.—The Ivanhoe-Regent Works of the General Electric Company, Cleveland, Ohio, have issued a folder on their Ace commercial lighting unit.

HOT WATER FAUCET.—The Hot-Flo Faucet Corporation, 1400 Broadway, New York City, has issued an illustrated folder covering its electric hot-water faucet.

ELECTRIC APPARATUS. — The Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has issued bulletin No. 137, describing its works and its products.

MULTIPLE PLUGS AND CURRENT TAPS.—Multiple plugs are the subject of circular matter No. 159 recently issued by Harvey Hubbell, Inc., Bridgeport, Conn.

ALUMINUM. — The British Aluminum Company, 265 Adelaide Street West, Toronto, Ontario, Canada, has issued a booklet entitled "The Casting of Aluminum."

STORAGE BATTERY.—The Gem Storage Battery Company, 343 South Dearborn Street, Chicago, has published a booklet on its acid-type electric storage battery.

FUSES.—The National renewable fuse is covered in a booklet recently distributed by the Federal Sign Systems (Electric) of Lake and Desplaines Streets, Chicago.

FANS, BLOWERS AND EXHAUSTERS. — The Buffalo Forge Company of Buffalo, N. Y., has issued section No. 400, covering its fans, blowers and exhausters.

SINGLE-PHASE MOTORS. — Bulletin No. 118 from the Wagner Electric Manufacturing Company of St. Louis, Mo., has for its subject Wagner single-phase motors.

ELECTRIC AEROPLANES.—Miniature electric aeroplanes are the subject of a folder which the A. E. Rittenhouse Company of Honeoye Falls, N. Y., has issued.

ALUMINUM SHEET. — The British Aluminum Company, 265 Adelaide Street West, Toronto, Canada, has prepared a booklet entitled the use of aluminum sheet.

CARPET WASHER. — The Hamilton Beach Manufacturing Company of Racine, Wis., is issuing a card which illustrates and describes its electrically driven carpet washer.

TABLEWARE. — The Edison Electric Appliance Company, 5660 West Taylor Street, Chicago, has issued an illustrated brochure on its "Hotpoint" silver-plated table ware.

VIBRATOR.—The Premier electric message vibrator is the subject of a booklet which has been issued by the Manhattan Electrical Supply Company, 17 Park Place, New York City.

COOKING EQUIPMENT.—Catalog No. 22, of eighty-eight pages, has been issued by the Duparquet, Huot & Moneuse Company, 108 West Twenty-second Street, New York City.

TRANSFORMERS. — The Pittsburgh Transformer Company of Pittsburgh, Pa., has published bulletin No. 2000, a twenty-four-page booklet showing installations of its transformers.

CLOTHES WASHER.—The new "Gold Seal" electric clothes-washing machine is the subject of a folder being distributed by the Philip Smith Manufacturing Company of Sidney, Ohio.

DISHWASHER. — The Bromley-Merseles Manufacturing Company, 837 Larrabee Street, Chicago, is circulating a folder entitled "Dependable Service" describing its "Crescent" glass and dishwashers.

DISHWASHERS. — Electrically driven dishwashing machines for use in hotels and restaurants are described and illustrated in a recently issued folder from the Insinger Company, 4651 Stenton Avenue, Wayne Junction, Philadelphia.

MOTOR-DRIVEN TOOLS. — The Stow Manufacturing Company of Binghamton, N. Y., has issued bulletin No. 103, covering its motor-driven tools. Bulletin No. 104 covers electrically operated tools using flexible shafts. These bulletins supersede all previous bulletins and catalogs issued by this company.

New Incorporations

THE TWIN CITY LIGHT & POWER COMPANY of Hampton, S. C., has been incorporated with a capital stock of $30,000 by R. H. Gibson and others.

THE LEXINGTON WILLYS LIGHT COMPANY of Lexington, Ky., has been chartered with a capital stock of $50,000 by C. P. Stout, James Kearns and A. D. Robertson.

THE BROFOR-WILLYS LIGHT & POWER COMPANY of Arkansas City, Kan., has been incorporated with a capital stock of $25,000 by F. R. Brown, Foss Farrar, J. F. Hunt all of Arkansas City and others.

THE J. W. BLAKE ELECTRICAL COMPANY of Wilmington, N. C., has been incorporated with a capital stock of $50,000 to do a general electrical business. The officers are: J. W. Blake, president and treasurer; A. B. Blake, vice-president, and Charles J. Hones, secretary.

THE BLUEBIRD COMPANY OF NEW ENGLAND of Worcester, Mass., has been incorporated by John P. Coghlin and David B. Kerr of Worcester, and C. Walter Jones of Brookline, Mass. The company is capitalized at $150,000 and proposes to manufacture electrical appliances.

THE BOONE BLOWING ROCK LIGHT & POWER COMPANY of Shulls Mills, N. C., has been incorporated by W. S. Whiting of Shulls Mills and George P. Hageman of Boone. The company is capitalized at $50,000 and proposes to operate an electric light plant in Shulls Mills.

THE ELDRIDGE ELECTRIC MANUFACTURING COMPANY of Springfield, Mass., has been incorporated by Arthur G. Wright, Ruth A. Wright of Springfield and Norman B. Ellison of Holyoke, Mass. The company is capitalized at $25,000 and proposes to manufacture electrical appliances.

THE MONROE ELECTRIC SUPPLY COMPANY of New York, N. Y., has been chartered by Samuel Feiner, Joseph A. Herman and Jacob Weiner, 5521 Fifty-sixth Street, Brooklyn, N. Y. The company is capitalized at $10,000 and proposes to deal in flashlights and electric novelties.

THE BAINBRIDGE (Ga.) POWER COMPANY has been incorporated with a capital stock of $100,000 to construct a hydroelectric plant at Spring Creek, Ga. The officers of the company are: J. M. Simmons, president; D. T. Sutherland, vice-president, and E. J. Perry, secretary and treasurer, all of Bainbridge.

THE UTILITY PRODUCTS CORPORATION of New York, N. Y., has been incorporated by F. H. Parce, G. Tiernan and J. B. Purcell, 64 Wall Street, New York City. The company is capitalized at $100,000 and proposes to manufacture electrical machinery, devices and supplies used in electric light, power and railway business.

Record of Electrical Patents

Notes on United States Patents

(Issued October 21, 1919)

1,319,307. SELECTIVE SWITCH FOR TELEPHONE AND TELEGRAPH SYSTEMS; Mathias W. Schumacher, Odanah, Wis. App. filed Dec. 24, 1915. For transmitting and receiving.

1,319,315. ELECTRICAL WATER HEATER; William Whelan, St. Joseph, Mo. App. filed June 27, 1918. Uses perforated heating plates.

1,319,365. PROCESS FOR THE MANUFACTURE OF ACETALDEHYDE; Ewald Steinbuch and Paul Schetelig, Basel, Switzerland. App. filed Sept. 25, 1918. Oxidizing action of current for transforming the mercury produced by reduction into active catalyst.

1,319,374. DEVICE FOR LIMITING THE MECHANICAL TENSION OF ELECTRIC LINE CONDUCTORS; Jacques O. Cahen, Epinal, France. App. filed Oct. 27, 1917. Maintains tension and sag by use of spring arrangement.

1,319,416. ELECTRIC SAFE AND VAULT PROTECTING DEVICE; Dexter M. Pease, Berkeley, Cal. App. filed March 12, 1918. Alarm connected to frame, doors and locks.

1,319,426. PREPARATION OF CRUDE MATERIALS FOR MANUFACTURE OF CALCIUM CARBIDE; Frank L. Slocum, Pittsburgh, Pa. App. filed Sept. 10, 1917. Briquetting hydrated lime with ground bituminous coal for reduction in electric furnace.

1,319,521. METHOD AND APPARATUS FOR ELIMINATING UNDESIRED VIBRATIONS; Reginald A. Fessenden, Brookline, Me. App. filed June 8 1917. By proportioning self-induction, resistance and capacity in a circuit, sound absorbed is varied.

1,319,524. IRON; Edward E. Garlits, Turtle Creek, Pa. App. filed June 3, 1919. Reinforced terminal members.

1,319,533. REPLACEABLE HEATING UNIT FOR ELECTRICAL APPARATUS; Harold A. Rice, New York, N. Y. App. filed June 5, 1917. Saves returning apparatus to dealer.

1,319,538. RENEWABLE-LINK ELECTRIC FUSE; John A. Thake, Brooklyn, N. Y. App. filed May 17, 1918. For plug fuses of small capacity.

1,319,542. PEDAL-OPERATED CONTROLLER FOR ELECTROMAGNETIC CHANGE-SPEED GEARS; Thomas Wardell Birmingham, Eng. App. filed March 25, 1918. Current strength a minimum when pedal is down and increases as pedal rises.

(Issued October 28, 1919)

1,319,559. ELECTRICALLY HEATED SHAVING CUP; Jacob H. Bjorkholm and Nils Ness, Astoria, Ore. App. filed Nov. 20, 1915. Heat generated by resistance element readily conducted within the inner receptacle.

1,319,642. SOCKET SHELL; Samuel Buchsbaum Chicago, Ill. App. filed July 21, 1917. For pendent switch.

1,319,651. ELECTRICAL MEASURING APPARATUS; Maclean Kirkwood, East Orange, N. J. App. filed Aug. 9, 1918. Determines magnitude of induced currents in telephone circuit.

1,319,715. ELECTROLYTIC APPARATUS; Ernest A. Le Sueur, Ottawa, Ont., Canada. App. filed March 30, 1917. Platinum sheet anode with spaced side walls as the cathode.

1,319,719. PROTECTIVE DEVICE; David T. May, New York, N. Y. App. filed Jan. 18, 1918. Vacuum arrester with two discharge gaps and magnetic field at longer gap.

1,319,720. PROTECTIVE DEVICE; David T. May, New York, N. Y. App. filed Jan. 18, 1918. Spark gap inclosed in a vacuum.

1,319,723. ALTERNATING CURRENT RELAY; Fritz Nolte, Berlin, Germany. App. filed April 1, 1916. Circuit in series through two contacts.

1,319,725. AUTOMATIC TELEPHONE SWITCH; John N. Reynolds, Greenwich, Conn. App. filed Jan. 8, 1918. Multiple terminals of outgoing circuits arranged in contact bank.

1,319,728. ELECTRICAL TEA HEATER; Wijtse B. Smits, Diemen, Kerlaan, Netherlands. App. filed April 29, 1919. Incandescent lamp with resistance in series.

1,319,733. ELECTRIC HEATER; Aaron Terry, Springfield, Mass. App. filed March 21, 1919. Comprises globular shells spaced apart.

1,319,734. MEANS FOR MAKING AQUEOUS SOLUTIONS OF GASES; Frederick W. Thorold, Edward G. R. Ardagh and James T. Burt-Gerrans, Toronto, Ont., Can. Chlorine gas from solutions of sodium chloride.

1,319,760. ELECTRICAL TERMINAL; Harry Dalitz, Cleveland, Ohio. App. filed March 1, 1919. Spring connector for positive attachment.

1,319,804. CRYSTAL DETECTOR FOR WIRELESS TELEGRAPHY; Martin G. Sjostrom, Upsala, Sweden. App. filed Aug. 17, 1916. Comprises crystal and contact.

1,319,825. ARC LAMP; Maurice J. Wohl, Brooklyn, N. Y. App. filed Nov. 23, 1917. Provides multiple arc.

1,319,853. INCANDESCENT ELECTRIC LAMP; Arthur R. Dennington, East Orange, N. J. App. filed April 12, 1918. With zigzag spring cutout for series of operations.

1,319,855. ELECTRIC REGULATOR; August W. Donop, Chicago, Ill. App. filed July 11, 1917. Compression type.

1,319,880. ELECTRIC-CURRENT-CONTROLLING DEVICE; Frederick B. Little, Chicago, Ill. App. filed Feb. 8, 1918. Circuit-breaker mechanism.

1,319,897. BATTERY-CHARGING UNIT FOR INTERNAL-COMBUSTION ENGINES; Carl E. Pearson, Lansing, Mich. App. filed Feb. 16, 1917. Sleeve on shaft actuates make-and-break.

1,319,915. ELECTRICAL CONNECTOR; William C. Tregoning, Cleveland, Ohio. App. filed April 16, 1919. For attachment plugs and receptacles.

1,319,920. ELECTRICAL CONNECTOR; Reuben B. Benjamin, Chicago, Ill. App. filed April 27, 1916. For caps on separable attachment plugs.

1,319,928. METHOD AND APPARATUS FOR BALANCING ROTORS; Absalom M. Kennedy, Cloverdale, Ala. App. filed June 2, 1919. Mass of body is altered electrolytically.

1,319,933. TELEPHONIC INSTRUMENT; William P. Stunz, Lansdowne, Md. App. filed July 22, 1915. Multiplies fluctuating current produced by voice or mechanical means.

1,319,940. ACCUMULATOR CELL; Chester M. Angell, Chicago, Ill. App. filed Sept. 6, 1918. Has positive interlocking and spacing mechanism.

1,319,941. BATTERY-COVER CONNECTION; Chester M. Angell, Chicago, Ill. App. filed Sept. 24, 1918. Uses ring of lead antimony alloy to grip terminal post.

1,319,963. PULL SOCKET; Harry J. Morey and Don N. Thompson, Syracuse, N. Y. App. filed June 20, 1917. For large current.

1,319,970. COVER LOCK; Joseph A. Schneider, Lakeport, Cal. App. filed Jan. 15, 1919. For commutator timers.

1,319,979. ELECTRICAL SWITCH; Richard Varley, Englewood, N. J. App. filed Nov. 21, 1917. Overcomes pre-ignition or other disturbances through sparking.

1,319,988. COMMUTATOR; Gustav Blumberg and John A. Buthkus, Baltimore, Md. App. filed Dec. 23, 1915. Made up of disks.

1,319,990. PROCESS OF UTILIZING HIGH-FREQUENCY ELECTRICAL OSCILLATIONS; David W. Brown, New York, N. Y. App. filed Aug. 27, 1917. Increasing effect of high-frequency oscillations upon detectors.

1,319,999. TELEPHONE-EXCHANGE SYSTEM; Charles L. Goodrum, New York, N. Y. App. filed Dec. 29, 1916. Operates any desired signal.

1,320,036. MEANS FOR ELECTRICALLY INDICATING THE PRESENCE OF SALINE, ALKALINE OR ACID IMPURITIES IN LIQUIDS; William C. Crockett, Glasgow, Scotland. App. filed Feb. 21, 1917. Impurities indicated by variation of electrical resistance.

1,320,040. HIGH-TENSION RECTIFIER; Charles Fayer, New York, N. Y. App. filed May 28, 1918. For X-ray work.

1,320,047. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Aug. 7, 1914. Regeneration control compensates for voltage fluctuations in supply voltage.

1,320,048. SYSTEM OF ALTERNATING-CURRENT RECUPERATIVE CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed April 29, 1915. Single-phase railway locomotive properly excited to effect positive and adjustable regeneration.

1,320,049. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Sept. 9, 1915. Maintains a substantially constant value of armature current.

1,320,050. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Dec. 2, 1915. Polyphase induction motors operated from a single-phase supply circuit through phase converter.

1,320,051. SYSTEM OF CONTROL; Rudolf E. Hellmund, Swissvale, Pa. App. filed Aug. 30, 1916. Causes over-compensating effect and subsequent neutralizing action.

1,320,052. SYSTEM OF CONTROL; Rudolf E. Hellmund, Swissvale, Pa. App. filed Aug. 30, 1916. Obtains steep speed-current characteristic.

1,320,053. SYSTEM OF CONTROL; Rudolf E. Hellmund, Swissvale, Pa. App. filed Oct. 24, 1916. Energizes main series field-magnet winding during regeneration.

1,320,054. SYSTEM OF CONTROL; Rudolf E. Hellmund, Swissvale, Pa. App. filed Jan. 6, 1917. Increase in regenerated current counteracted by decrease in field excitation.

1,320,055. SYSTEM OF CONTROL; Rudolf E. Hellmund, Swissvale, Pa. App. filed March 28, 1917. Predetermined compounding effect imparted to machines individually.

1,320,056. COIL-RETAINING DEVICE FOR DYNAMO-ELECTRIC MACHINES; Rudolf E. Hellmund, Swissvale, Pa. App. filed June 8, 1917. Composed only in part of conducting material.

1,320,057. SYSTEM OF CONTROL; Rudolf E. Hellmund, Swissvale, Pa. App. filed Sept. 7, 1917. Armatures connected in series across supply circuit.

1,320,058. CONTROL SYSTEM; Rudolf E. Hellmund, Swissvale, Pa. App. filed Sept. 8, 1914. Adapted to regenerative current when driven by momentum.

1,320,071. FURNACE-REGULATOR SYSTEM; Edwin Lehr, Pittsburgh, Pa. App. filed March 19, 1919. Either manually or automatically maintained.

1,320,074. ELECTRICAL SYSTEM; Walter O. Lum, Wilkinsburg, Pa. App. filed Nov. 6, 1915. Automatic stop or tripping device for ore buckets.

1,320,078. SWITCHING DEVICE; Howard G. McDonald, Murraysville, Pa. App. filed July 11, 1916. Starting-switch interlock.

1,320,083. SYSTEM OF ELECTRICAL DISTRIBUTION; Charles McL. Moss, Pittsburgh, Pa App. filed June 4, 1915. Selectively disconnecting faulty feeders.

1,320,087. MERCURY-ARC LAMP; Perley G Nutting. Wilkinsburg, Pa. App. filed March 13, 1913. For laboratory purposes.

1,320,106. HIGH-TENSION ROTARY RECTIFIER; Reinhold H. Wappler, Yonkers, N. Y. App. filed May 29, 1918. For X-ray work.

1,320,114. SEAL; Wilfred T. Birdsall, Montclair, N. J. App. filed Oct. 9, 1915. Vacuum tight over wide temperature ranges.

1,320,118. Water Purifying and Filtering Device; Elmer L. Brillhart, Chicago, Ill. App. filed Aug. 13, 1917. Bacteria killed electrically.

1,320,119. Scale Mechanism for Electrical Measuring Instruments; Richard P. Brown and Charles P. Frey, Philadelphia, Pa. App. filed Jan. 6, 1919. Instrument with rotatable supporting base for slide wire.

1,320,120. Scale Mechanism for Electrical Measuring Instruments; Richard P. Brown, Charles P. Frey and Friedrich Wagner, Philadelphia, Pa. App. filed March 4, 1919. For use with rheostat in form of slide-wire potentiometer.

1,320,123. Electric Arc-Welding System; Albert M. Candy, Wilkinsburg, Pa. App. filed Sept. 7, 1917. Arc circuits independent of each other.

1,320,125. Circuit-Interrupting System; Lewis W. Chubb, Edgewood Park, Pa. App. filed Oct. 7, 1915. Converter are extinguished under predetermined conditions.

1,320,126. Coil-Retaining Device for Dynamo-Electric Machines; Adolphus M. Dudley, Oakmont, Pa. App. filed May 26, 1917. Locked in position by wedging action.

1,320,127. Automatic Control of Welding Arcs; Otto H. Eschholz, Wilkinsburg, Pa. App. filed Aug. 26, 1918. Limits arc length to predetermined value.

1,320,135. Plug; David D. Gordon, Chicago, Ill. App. filed March 6, 1916. Direct connection with one of contact elements.

1,320,140. Wireless Transmission of Signals; Earl C. Hanson, Los Angeles, Cal. App. filed Aug. 27, 1917. Employs transformers with iron cores.

1,320,142. Audio-Frequency-Controlled Torpedo; Earl C. Hanson, Los Angeles, Cal. App. filed June 4, 1918. Dirigible vessel controlled by aeroplane.

1,320,150. Socket and Attachment Plug; William V. D. Kelley, Brooklyn, N. Y. App. filed July 20, 1916. Automatic thermostatically controlling switch.

1,320,154. Switchboard or Switch Panel; Hubert F. Krantz, Brooklyn, N. Y. App. filed July 11, 1913. For three-wire system.

1,320,155. Electrical Heating Unit; Frank Kuhn and Jay A. Hand, Detroit, Mich. App. filed Jan. 25, 1917. Exposed resistor type.

1,320,156. Electrically Heated Tool; Frank Kuhn, Jay A. Hand and Jules G. Spies, Detroit, Mich. App. filed Nov. 14, 1916. Soldering irons readily detached and reassembled.

1,320,196. Receptacle; Reuben B. Benjamin, Chicago, Ill. App. filed Nov. 6, 1915. Charged parts rendered difficult of access when insertible device is removed.

1,320,200. Resistance Unit; George W. Camp, Mount Vernon, N. Y. App. filed Feb. 20, 1917. Terminal member outside the tube.

1,320,242. Contact Plug; William J. Koenig, Brooklyn, N. Y. App. filed Jan. 6, 1919. Single-contact type.

1,320,300. Production of High-Tension Discharges; William H. Wilson, Norbiton, Eng. App. filed June 1, 1914. Utilization of condensers.

1,320,308. Aeroplane Signal; Eben G. Balch, Newburyport, Mass. App. filed July 23, 1918. Variable signals transmitted through great distances.

1,320,317. Automatic Organ; John Haywood Compton, Nottingham, Eng. App. filed Dec. 26, 1916. Controlled by perforated music roll.

1,320,366. Optiphone; William G. Houskeeper, Philadelphia, Pa. App. filed Oct. 20, 1917. A light sensitive element for signal indication.

Issued Nov. 4, 1919.

1,319,989. Apparatus for Receiving Hertzian Waves; David W. Brown, New York, N. Y. App. filed May 26, 1917. Reinforces effect of oscillations upon detectors.

1,320,390. Lifeboat Radiosignaling System; Earl C. Hanson, Washington, D. C. App. filed Feb. 20, 1919. Emergency signaling.

1,320,424. Fuse Plug; Karl B. Shulz, New York, N. Y. App. filed Feb. 12, 1919. Easily refilled.

1,320,431. Method and Apparatus for Stretching Out Long Double or Multiple Electric Arcs; Frans H. Wielgolaski, Christiania, Norway. App. filed Sept. 28, 1916. Arc driven into separate furnace space by gas current.

1,320,487. Electric Regulating Apparatus; George G. Milne, Rye, N. Y. App. filed June 18, 1915. Regulation by temperature variations on magnet windings.

1,320,525. Wireless Telegraphy; Ralph R. Beal, Palo Alto, Cal. App. filed July 28, 1915. Receiving system for reducing frequencies.

1,320,529. Insulating Switch Shell; Tonjes A. Both, Stratford, Conn. App. filed Dec. 20, 1918. Light porcelain shell to fit standard sockets.

1,320,544. Pyrometer Switch; Claud S. Gordon, Chicago, Ill. App. filed June 16, 1916. Push-button type contact switch.

1,320,564. Motor Controller; Niels L. Mortensen, Milwaukee, Wis. App. filed March 26, 1915. Effecting acceleration and graduated dynamic braking.

1,320,594. Apparatus for the Attachment of Electric Wires to Terminals; Henry Windibank, Croydon, Eng. App. filed Dec. 21, 1918. Terminal clip.

1,320,595. Electrical Switch; Frederick Zenker, Highland Park, Mich. App. filed June 20, 1917. Inclosed knife type.

1,320,598. Electromagnet; Oscar R. Blumberg and Bryson D. Horton, Detroit, Mich. App. filed June 2, 1914. Minimized humming and chattering in magnets.

1,320,610. Apparatus for Detecting and Indicating the Presence of Submarine Boats; Giovanni E. Elia, New York, N. Y. App. filed Feb. 3, 1917. Signals by wireless.

1,320,619. Connecting Device for Electrical Switches; Bryson D. Horton, Detroit, Mich. App. filed Dec. 29, 1914. Single piece of metal slotted and bent.

1,320,624. Magnetic Attachment for Engines and the Like; Herman L. Keun, Chicago, Ill. App. filed May 6, 1918. Separates foreign matter from oil.

1,320,677. Electric Switch; William .W. Dryden, Philadelphia, Pa. App. filed Sept. 21, 1917. Contacts with rectilinear member.

1,320,685. Radio Telegraphy and Telephony; John Hays Hammond, Jr., Gloucester, Mass. App. filed May 29, 1912. One generator for telegraphing and telephoning.

1,320,686. System of Acoustic Signaling; John Hays Hammond, Jr., Gloucester, Mass. App. filed June 10, 1912. Telegraphic shorthand system.

1,320,704. Electric Switch; James M. Naul, Plainfield, N. J. App. filed March 10, 1916. Prevents unauthorized switch movement.

1,320,747. Generator and Storage-Battery System for Lighting, etc.; James K. Elderkin, Jr., Newark, N. J. App. filed Jan. 24, 1918. Automatic voltage regulation on removing battery.

1,320,781. Dynamo-Electric Machine; Paul A. H. Mossay, London, Eng. App. filed Jan. 30, 1918. Inclosed-motor cooling system.

1,320,787. Hydrocarbon Vaporizer; William W. McElrath, Jr., East Radford, Va. App. filed March 29, 1918. Makes use of heavy hydro-carbons.

1,320,789. Dynamo-Electric Machine; Frank D. Newbury, Pittsburgh, Pa. App. filed April 12, 1915. Braking alternating-current generators of the water-wheel type.

1,320,795. Armature; John W. Pearson, Chicago, Ill. App. filed Aug. 7, 1916. For direct-current railway service.

1,320,805. Process for the Extraction of Zinc; Robert H. Stewart, Vancouver, B. C., Can. App. filed Oct. 21, 1918. Rendered soluble by roasting and recovered by electrolytic deposition.

1,320,846. Portable Electric Light; John T. Drufva, Longmeadow, Mass. App. filed Dec. 22, 1917. Spring attachment prevents breaking of bulb.

1,320,870. Air-Break Switch; Carl G. Koppitz, Greensburg, Pa. App. filed July 9, 1917. Automatic trip mechanism.

1,320,884. Electric Furnace; Carlo Masera, Turin, Italy. App. filed Dec. 9, 1918. For refining steel and metallic alloys.

1,320,890. Electric Water Heater; Frederick W. Moffat, Weston, Ontario, Can. App. filed Feb. 13, 1919. Resistance units in cylindrical water jacket.

1,320,894. Electric Welding Apparatus; Thomas E. Murray, Jr., Brooklyn, N. Y. App. filed May 2, 1919. Makes uniform weld.

1,320,895. Electric Welding Apparatus; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed April 10, 1919. Mechanism clamps work and exerts pressure during welding.

1,320,896. Method of Controlling Electric Welding Machines; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed April 10, 1919. Prevents injury to switch mechanism.

1,320,897. Apparatus for Electrical Welding; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed May 31, 1919. Both heat and pressure applied.

1,320,927. Motor Control; Claude C. Runner, Schenectady, N. Y. App. filed Jan. 2, 1917. Push-button control.

1,320,941. Electrical Water Heater; Frederick Taylor, Kakabeka Falls, Ont., Can. App. filed April 5, 1919. Water passes through suspended concentric tubes.

1,320,959. Radiosignaling System; Ernst F. W. Alexander, Schenectady, N. Y. App. filed Oct. 16, 1917. Transmits signals by radio-frequency currents.

1,320,971. Propelling and Braking Means for Traveling Cranes and Carriages; Melvin B. Benson, Superior, Wis. App. filed Oct. 28, 1918. Operated by compressed air.

1,320,980. Transformer; Herman N. Bowman, New York, N. Y. App. filed Sept. 21, 1918. Prevents electrostatic induction between the windings of repeating coils.

1,320,992. High-Tension Locking Switch; Edson O. Sessions, Chicago, Ill. App. filed Sept. 6, 1917. For high-voltage alternating-current transmission lines.

1,320,994. Electric Regulator; William A. Turbayne, Niagara Falls, N. Y. App. filed April 23, 1917. Stable throughout wide range.

1,320,995. Lamp-Voltage Regulator; William A. Turbayne, Niagara Falls, N. Y. App. filed July 18, 1917. Compressible-pile type.

1,321,019. Motor Control; John Eaton, Schenectady, N. Y. App. filed Jan. 2, 1917. Automatic push-button control.

1,321,023. Electric Lighting Fixture; Henry A. Framburg, Berwyn, Ill. App. filed March 21, 1918. Adjustable mechanism secures correct focal distance.

1,321,042. Speed-Regulating Set; John I. Hull, Schenectady, N. Y. App. filed July 26, 1916. For induction motors.

1,321,071. Heater for Linotype Pots; William S. Hadaway, Jr., New Rochelle, N. Y. App. filed Dec. 23, 1915. Internal mouth and throat type.

Issued Nov. 11, 1919

1,321,078. Wire Hanger; Arthur O. Austin, Barberton, Ohio. App. filed May 24, 1916. Grooved catenary type.

1,321,104. Rheostat; Leonard Kebler, Bronxville, N. Y. App. filed Feb. 11, 1919. Metal base with several glazed coatings.

1,321,136. Electric Riveter; Wensel Morava, Chicago, Ill. App. filed Sept. 22, 1917. Plunger type.

1,321,144. Panelboard; Clarence D. Platt, Bridgeport, Conn. App. filed May 18, 1918. Sectional panels with common ground bar.